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A FACTOR ANALYSIS OF THE WECHSLER PRESCHOOL AND PRIMARY SCALE OF INTELLIGENCE AND SELECTED SCREENING TESTS OF ACADEMIC READINESS

BY

©

W. R. MORROW

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ABSTRACT

In the present study the factor structure and the psychoeducational diagnostic utility of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) and selected screening tests of academic readiness were investigated. The sample population included 40 achieving and 40 nonachieving children in the 60 to 78 month age range. The results of the analyses of the data indicated that the children in the achieving and nonachieving groups differed in several respects.

Major findings of this investigation were: (a) the nonachieving children presented as a heterogeneous group with language and perceptual skills emerging as common factors in daily academic functioning; (b) the heterogeneity of the learning problems of the nonachieving children was confirmed by statistical classification and empirical procedures; (c) the level of intelligence, as measured by the WPPSI, did not have a direct influence on the level of performance of the nonachieving children on the screening tests of academic readiness; (d) patterns of test scores for the achieving children were found to exist, but the patterns appeared to represent normal variations rather than patterns of deficit functioning; (e) three WPPSI subtests may be useful in identifying children with learning problems and a short screening battery of readiness tasks may be useful in direct assessment of academic readiness skills; (f) although some differences were found, the two factor structure of the WPPSI for both achieving and nonachieving children was the same; (g) no freedom from distractibility or third specific WPPSI factor was found; (h) the WPPSI factor structure did not

conform completely to Bannatyne's (1974) subtest categorization.

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CHAPTER I

HISTORICAL OVERVIEW LEADING TO THE NEED FOR EARLY IDENTIFICATION OF LEARNING DISABLED CHILDREN

The field of learning disabilities is a relatively new area of special education. As is the case with emerging disciplines, the field is characterized by ongoing professional debate concerning theory and practice. In recent years societal pressures have led to changes in the field of learning disabilities and in other areas of special and basic education. Haight (1980) describes the learning disabilities field as a battered discipline whose professionals are abused by the unrealistic expectations of administrators and parents. The expectations take the form of identifying and teaching greater numbers of learning disabled children with lasting academic results.

Emerging trends in the field and rising social expectations challenge the learning disabilities professional to become more efficient. The challenge is likely to be keenly felt by those professionals responsible for the identification and the psychoeducational diagnosis of learning disabled children. Accurate identification and valid diagnosis are important elements of the process of educating learning disabled children. In order to meet increasing societal expectations concerning the learning disabled, professionals in the field require proven identification and diagnostic methods.

A learning disability is generally considered to be one of the handicapping conditions on a continuum of exceptionality (Hallahan & Kaufman, 1978). Many definitions of learning disability exist. An analysis of existing definitions usually yields two types. One group of definitions indicate that learning disabilities occur because of organic causes within the child. The definition of Johnson and Myklebust is an example of this first type: "We refer to children as having a psychoneurological learning disability, meaning that behavior has been disturbed as a result of dysfunction of the brain" (1968, p. 8).

The second type of definition is characterized by emphasis on the behavioral and educational manifestations of a learning disability. The definition written by an American congressional committee in 1968 is an example of this type:

> Children with specific learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or using spoken or written language. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic. (National Advisory Committee in Lerner, 1976, p. 9)

The two definitions illustrate a theoretical division in the field of learning disabilities. Individuals such as Gaddes (1978) and Hoffman (1974) support the neurological bias evident in the definition of Johnson and Myklebust. Others such as Keogh (1972) and Ross (1977) appear to favor the educational bias explicit in the second definition. The polarization of groups with neurological and educational biases illustrates a problem of definition and classification that hinders the effective identification of learning disabled children. Professionals working with learning disabled children are caught in what Meier (1976) describes as a paralysis of analysis. The definition issue appears to be somewhat resolved by calls for interdisciplinary and time-consuming cooperation in identifying and assessing learning disabled children (Hagin & Silver, 1974; Meier, 1976). Proven methods of identifying the learning disabled are required if the educational needs of these children are to be met in the classroom.

In the field of learning disabilities other issues exist. An emerging trend in the field is to include other primary handicapping conditions if learning disabilities are also identified (Hallahan & Kaufman, 1976). Hitherto, most definitions of learning disability have contained an exclusion clause for children who were socially deprived, intellectually or emotionally handicapped. Lerner (1976) describes this new trend as the cross categorical movement; the movement receives increasing support from Garret and Brazil (1979) and others who oppose the stigmatizing labelling of children.

A second issue concerns the nature of specific learning disabilities. Researchers such as Adelman (1978) and Hallahan (1975) report that learning disabilities are heterogeneous rather than homogeneous in nature: a specific learning disability is not unitary but a complex handicap manifested in different ways by different children. Two children each with a specific reading or a psychomotor disability present unique characteristics that best illustrate their areas of strength and learning dysfunction.

The consequences of the cross categorical and homogeneity-heterogeneity issues are certain. First, those professionals responsible for the identification and the assessment of learning disabled children will likely face increasing pressure to describe specific learning problems rather than to label children in order to make placement decisions. Second, sufficient cause exists to question the use of global, psychometric measures in assessing and placing learning disabled children in remedial programs. Grouping children and then planning remedial strategies according to identified areas of learning dysfunction would possibly make remedial intervention more efficacious. Other issues exist that lend support to the notion of re-examining assessment procedures with learning disabled children.

The regular program integration of handicapped children is an issue that affects all areas of education. Nowhere is the issue more apparent than in the United States. Turnbull (1975) and Zettle and Weintraub (1978) describe a trend in American litigation between 1960 and 1978 as affirming the rights "of all school children, regardless of the severity of their handicap, to a free public education" (Zettle & Weintraub, 1978, p. 10). The 1975 Public Law (PL) 94-142: The Education For All Handicapped Children Act resulted from public awareness of the needs and rights of handicapped children. PL 94-142 provides a statutory guarantee of the right of every handicapped American child, including the learning disabled, to a free and appropriate education. Within a due process framework, PL 94-142 clearly specifies procedures for the identification, placement and education of handicapped children in American schools.

According to Judkins (1979), the status of legislative guarantees in Alberta is similar to the period in the United States prior to the enactments of PL 94-142. The Alberta School Act contains no provisions for mandatory special education programs (Mattu, 1980). Recently, an Alberta court ordered a school system to provide educational services to a cerebral palsied child (Carriere versus the County of Lamont, 1978). The case may signify the beginning of a trend in Alberta toward the type of measures included in PL 94-142.

Several conclusions may be drawn from the legal events described. The precedent-setting Carrier case affirms the right of handicapped children in Alberta to a public education. Although statutory mandates of the PL 94-142 type are not yet in force in Alberta, professionals should anticipate the need for research to validate screening and diagnostic methods. Whether provision is made by statute or not, educators require valid information in order to plan an appropriate and in some cases, individual education program. With reference to the assessment of learning disabled children, Adelman (1978) states, "There is no satisfactory evidence that such differential diagnosis is being made reliably and validly" (p. 724). Further research into methods of assessing learning disabled children appears to be warranted.

Lerner (1976) describes a discrepancy criterion used in the identification of learning disabled children. A discrepancy between a child's IQ level and academic task performance is one traditional criterion used to identify and to make program placement decisions. The Alberta Special Education guidelines (1980) mandate the use of an individually administered intelligence test, as a measure of potential relative to academic achievement, in psychological assessments of the learning disabled and other handicapped children. Because of the time required to administer individual intelligence tests, many school psychologists are able to identify but are unable to diagnose the problems of the learning disabled (Hallahan and Kaufman, 1976). As a consequence, classroom teachers and others have complained about the lack of diagnostic information in psychological reports (Keogh, 1972).

According to Matarazzo (1971), the intelligence test has a long tradition of clinical use. Fisk (1979) reports that intelligence tests have been useful in predicting learning problems of children. However, Fisk also claims that professionals have difficulty explaining student underachievement when IQ scores alone are considered. Book (1974) makes a similar judgement when he writes: "Intelligence tests represent a global rather than a differential evaluation" (p. 52). Keogh (1972) is also critical of the global undifferentiating nature of intelligence tests.

In the past decade researchers such as Hagin and Silver (1974, 1971) have recognized the potential use of intelligence tests in identifying and in diagnosing the problems of learning disabled children. Hagin and Silver report, "The assessment of cognitive functioning is a basic aspect of the diagnosis of learning disability" (1971, p. 221). The main characteristic of the work of Hagin and Silver, and other researchers, is a search for patterns of subtests scores on intelligence tests that are useful in the identification of homogeneous subgroups of learning disabled children. Several studies that describe the use of subtest score patterns in the identification and diagnosis of learning disabled children will be reviewed briefly.

Bannatyne (1968) describes a method of using subtest scores from the Wechsler Intelligence Scale for Children (Wechsler, 1967) in the diagnosis of children with reading problems. Based on his own studies of dyslexic children (1971) and on factor analyses of the WISC and the revised WISC, Bannatyne (1974) recommends the use of three categories of subtest patterns in the differential diagnosis of learning disabled children. Bannatyne's recategorization of WISC-R subtests provides a method for diagnosticians to generate remedial hypotheses from ability profiles. The recategorization represents an objective method for determining specific areas of learning dysfunction. Because of the empirical support for Bannatyne's categorization, the method appears to hold promise as one tool that can be used by the clinician in the diagnosis of student learning problems.

Hallahan (1975) reports that the major thrust of the research of intelligence test subscore patterns is with school-aged children. A review of the literature on learning disabilities indicates that most reported studies are of school-aged children. However, another emerging trend in the field of learning disabilities is a growing emphasis on the early identification of preschool learning disabled children. Writers such as Meier (1976), Keogh (1972, 1977) and Telegdy (1979) describe a concept of early identification of the learning disabled.

As part of a preventative strategy, young children are screened for learning problems; those children identified with learning problems undergo further diagnosis and, if necessary, they complete remedial and compensatory educational activities. The benefit to a child is that later learning problems in school may be minimized or prevented by early identification and educational intervention.

The need for preschool screening for the early identification and diagnosis of learning disabled children is recognized. The University of Alberta Senate Task Force (1979) concludes: "When early signs of learning disabilities are evident . . . identification and diagnosis of the problem and appropriate intervention can be preventative" (p. 18). The principle of early identification for intervention receives support from Colligan and O'Connell (1974) who advocate psychometric screening as part of a pediatric preschool examination. Keogh and Becker (1973), Keogh (1972), Meier (1976) and Beatty (1975) all advocate the early identification of learning disabled children. Although the principle of early identification receives support, as in most areas of assessment, operational problems are present.

Sahin (1978) and Scherr, Pasework and Sawyer (1973) point out the cost benefit advantages of validating time effective screening tests. Scherr and his colleagues state that "Individual intelligence tests are too time consuming to be useful in early screening practices" (1973, p. 466). Crofoot and Bennett (1980) report that school systems and others involved with the assessment of students are beginning to "search for screening tests that can be given quickly while maintaining adequate reliability and validity" (p. 474). The search for time effective and valid screening tests appear to be generally supported.

One of the problems in the search for effective preschool screening tests involves predictive test validity. Flynn and Flynn (1978) suggest that "the selection of a valid screening battery is not yet complete and new or refined instruments must be evaluated" (p. 69). Keogh and Becker (1973) support the need for continued test evaluation, particularly when tests are to be used to identify young learning disabled children who are in a state of rapid maturation. Several longitudinal studies of young learning disabled children are presently under way and will be reviewed. The results of these studies are encouraging in that they support the utility and the predictive validity of screening procedures.

Diagnosticians have access to an existing intelligence test that may have validity in the identification and assessment of learning disabled preschoolers. The Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 1967) is an individually administered scale. Sattler (1974) reports that the WPPSI yields useful clinical and diagnostic information on the preschool child. Eichern (1972) states, "The WPPSI is the best standardized and most up-to-date individual test available of its kind" (p. 807). The WPPSI is similar in content to the Wechsler Intelligence Scale for Children (WISC, 1949) and the 1974 revised WISC (WISC-R). The construction of the WPPSI is based on David Wechsler's theoretical rationale: "Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (Matarazzo, 1972, p. 79).

Wechsler (1967) assumes that the global nature of intelligence can be measured and described by the analysis of responses and the combination of subtest scores on a battery of tests. Wechsler (1967) also assumes that intellectual development after age four is continuous rather than the sequentialized appearance of separate abilities. Wechsler's assumptions underscore his use of similar tasks to measure intelligence across different age levels. Because Wechsler's intelligence tests are point scales that have similar content, a method is provided for cross-age comparisons of the intellectual development and responses of normal and learning disabled children.

The WPPSI and the other Wechsler scales are standardized on normal populations of children. Unlike the other Wechsler scales, "Published research reports on the WPPSI are still meager" (Pasework, Rardin & Grice, 1971, p. 43). In the last decade, research reports on the WPPSI have become available. The research is correlational in nature and much of it is conducted to determine the validity of the WPPSI. For example, Crockett, Rardin and Pasework (1975) report correlations of WPPSI, WISC-R and Stanford Binet IQ scores of culturally disadvantaged children. A similar study is reported by Yates, Boyd and Barclay (1975). The results of such studies support the concurrent validity of the WPPSI. Others such as Kaufman (1973) describe the effects of socioeconomic status and sex differences on WPPSI IQ scores. Fairweather (1977) also describes sex differences in WPPSI test responses. Although the effect of gender is observable on two or three WPPSI subtests, Yates, Boyd and Barclay (1975) claim that these studies have nonsignificant results. In a longitudinal study Wilson (1975) administered the WPPSI to identical twin pairs at the age of four, five and six years. Wilson reports a distinctive pattern of subtest scores that is duplicated by each pair of twins over the three-year period. Although Wilson's evidence of test-retest stability of WPPSI subtest scores supports the reliability of the WPPSI for intellectually normal populations, further research is required with exceptional populations including young learning disabled students.

Henderson and Rankin (1973) make the point that there has been little research on the diagnostic value of the WPPSI. Henderson and Rankin also state: "To our knowledge, the utility of the WPPSI as a predictor of later school performance has not been demonstrated with any population" (1973, p. 19). Although researchers such as Hagin (personal correspondence) have recently completed diagnostic studies with the WPPSI, the professional literature contains few articles on the topic. Henderson and Rankin's statement provides evidence of the paucity of and the need for research on the validity of the WPPSI. In order to be of use to professionals concerned with test measurement, the psychometric qualities of tests should be specified for a given population under certain conditions. Information on the psychoeducational utility and measurement properties of the WPPSI and preschool screening tests is not presently available for learning disabled children.

Because of the need for continued research at the preschool level, a downward extension of the diagnostic methods used with the WISC and the WISC-R appears to be a promising area of inquiry. Not only does this direction of inquiry have the advantage of employing the WPPSI as an accepted and widely used test instrument, but descriptions of diagnostic methods using the WISC and WISC-R with school-aged children exist. It is possible to replicate these procedures for use in identifying and diagnosing learning disabled preschool children.

The factor analytical methods of Cohen (1959) and Kaufman (1975) and the diagnostic procedures of Bannatyne (1974, 1968) serve as models for the present study. Silverstein (1969) describes Cohen's factor analysis of the WISC standardization population as a classic of its kind. Cohen's (1959) study of age effects on patterns of WISC subtest scores serves as a prototype for later studies by researchers such as Kaufman (1975). Few factor analytic studies of the test results of learning disabled children are reported; therefore, a logical line of inquiry is presented. The use of multivariate methods of analysis similar to that of Cohen (1959) and Kaufman (1975) provide means to compare patterns of test responses of normal and learning disabled children. If unique patterns of subtests are observable for learning disabled children and if such patterns are significantly related to responses on screening tests, the validity of selected screening tests may be assessed.

The psychoeducational utility of selected tests is assessed in the present study. One of the purposes of the study is to determine whether selected psychological tests can be used to differentiate and diagnose the problems of young learning disabled children. The need to evaluate preschool assessment measures is evident. Early identification and remedial programming of learning disabled children may prevent later school learning problems from occurring. Continued validation of methods of diagnosis is necessary; the emphasis given to clinical teaching presumes accurate identification and diagnosis. Constitutional mandates for an appropriate educational program for learning disabled children make valid diagnosis necessary; similar constitutional guarantees are likely to be in force in the Province of Alberta. Practices dealing with special education coupled with legislative pressure put on psychologists to do something for learning disabled children, make it necessary for us to continue research into methods of identification and psychoeducational diagnosis.

The present study was designed to seek answers to questions regarding: (a) the factor structure of the WPPSI; (b) the psychoeducational diagnostic utility of the WPPSI and screening tests of readiness for academic learning; (c) the relationship between patterns of test scores within and between subgroups of achieving and nonachieving children. The purpose of the study was to determine whether tests of school readiness and intelligence would prove to be useful in the early identification of children with learning problems.

CHAPTER II

REVIEW OF THE RESEARCH: APPLICATIONS OF FACTOR ANALYSIS

The studies reviewed for the present chapter are described in three sections. Factor analytic studies of the WISC, WISC-R and WPPSI are reviewed first. Diagnostic studies utilizing the three Wechsler scales are then reviewed. The efficacy of screening test procedures is discussed in the last section.

Review of Factor Analytic Studies

Cohen was one of the first researchers to use factor analytic methods to describe the subtest scores of individuals in the 1949 WISC standardization sample. Cohen (1959) presented the results of a factor analysis of the subtest scores for children at three age levels in the standardization group. His aim was to provide ". . . for the first time direct scrutiny of changes in intellectual organization concomitant with age" (Cohen, 1959, p. 292). In addition, Cohen described a method of using patterns of subtest scores in interpreting the WISC.

Based on the results of his factor analysis of the WISC, Cohen (1959) identified three meaningful factors each loaded by specific subtests. The Information, Comprehension, Similarities and Vocabulary subtests formed a Verbal Comprehension factor. A Perceptual Organization factor was formed from a grouping of the Block Design, Mazes and Object Assembly subtests. According to Cohen (1959), the WISC Digit

Span and Arithmetic subtests combined for a third factor, Freedom From Distractibility. Cohen intended that the factor scores be determined for a child by averaging the scores of the subtests on each factor; a factor score was compared to the WISC mean and to the other factor scores for purposes of interpretability.

The study by Cohen (1959) is important for several reasons. The study provided a replicable model for cross age comparisons of intellectual skills as measured by a test such as the WISC. An issue of subtest specificity or interpretability was raised which, in addition to the notion of factor scores, led other researchers to pursue similar lines of inquiry. In addition, Cohen's (1959) description of WISC subtest patterns provided a useful diagnostic tool for use in student assessment.

Following the example set by Cohen with the WISC, Kaufman (1975) described a factor analysis of the 1974 WISC-R standardization sample. Kaufman's methods of factor analysis differed from those employed by Cohen. In addition to analyzing the results of a more contemporary sample on the revised test, Kaufman used different statistical procedures. Cohen (1959) used an oblique factor method and made an arbitrary decision based on previous research on the Wechsler Adult Intelligence Scale to exact five factors. Kaufman used objective techniques in order to determine the number of factors to rotate using both oblique and orthogonal techniques. In Kaufman's study, principal factor analysis was followed by varimax rotation of two, three, four and five factors. Kaufman (1975) concluded that a three factor rotated solution was the most sensible for interpreting his results.

For nine of the eleven age levels included in the study, Kaufman (1975) described three factors as having invariant subtest loadings. Factor A was identified as Verbal Comprehension, Factor B as Perceptual Organization and, Factor C as Freedom From Distractibility. Developmental trends were in evidence at the six year six month age level; the Information and Comprehension subtests having low loadings on Factor A and Factor C emerged in the orthogonal but not in the oblique rotations. Kaufman concluded, "Factor C may not emerge strongly until age seven or seven and one-half" (1975, p. 147).

Despite the discrepant scores for the youngest age group of children and without any further explanation, Kaufman recommended the use of his factors in interpreting WISC-R results across all age levels (1975, p. 146). The WISC-R subtests loading on Kaufman's factors were essentially the same as these found by Cohen (1959). The Vocabulary, Information, Comprehension and Similarities subtests of the WISC-R loaded on Factor A. Factor B was loaded by the Block Design, Object Assembly and Picture Completion subtests; the Arithmetic and Coding subtests loaded on Factor C. Kaufman (1975) concluded that the factor scores, i.e., the average of the subtests loading the factors, could be used to compare patterns of intellectual functioning.

The studies by Cohen (1959) and Kaufman (1975) indicated that specific WISC and WISC-R subtests loaded three factors. In addition, invariant subtest loadings were found in the factors across the age levels for which the WISC and WISC-R were intended indicating that intellectual skills may be continuous between the age of six and sixteen years. However, possible discontinuity in the skill development of younger children was indicated; both authors reported that the Freedom From Distractibility factor did not emerge strongly in young children. Because of the possible effects of maturation, additional research of the subtest patterns of younger children appears to be warranted.

Sattler (1974) claimed, "There are differences evident in the factor analytic studies of the WPPSI" (p. 227). The differences appeared to be related to the procedures used and the results found in the WPPSI studies. As in the studies of the WISC and WISC-R, most factor analytic studies of the WPPSI were of the original standardization group; consistent findings of one general and two group factors were reported.

Hollenback and Kaufman (1973) described an earlier WPPSI study completed but unreported by Cohen: "Cohen used the centroid method with the six age groups in the WPPSI standardization sample. . . . His results suggested that there may be only two meaningful factors--verbal and performance" (p. 41). No description of Cohen's study was available in the literature; however, the identification of two factors was replicated in later studies. Two recent analyses of the original WPPSI standardization group provide interesting data.

Hollenback and Kaufman (1973) employed different procedures to factor analyze the WPPSI scores at three age levels for the original standardization group. Hollenback and Kaufman concluded, "Regardless of the factor analytic technique used, two factors appeared--one clearly verbal and the other clearly performance--at each of the three age levels" (1973, p. 42). In addition, these researchers reported that 11 subtests loaded significantly on a large, general factor. Hollenback and Kaufman (1973) reported that the Arithmetic subtest loaded on both factors across the three age levels and that the Picture Completion and Animal House subtests loaded highly on both factors at the lower age levels. The authors speculated that the performance requirements of the Arithmetic subtest contributed to the high loadings on both factors. They also hypothesized that a verbal mediation component, which diminishes with age, affected performance on the Picture Completion and Animal House subtests at the four year age level.

Wallbrown, Blaha and Wherry (1973) also factor analyzed the subtest scores of children in the original WPPSI standardization sample. These researchers reported a pattern of subtest loadings on a general intelligence factor and on two group factors. Wallbrown and his colleagues reported: "The only consistent exception is the Arithmetic subtest which tends to split about evenly between the Verbal and Performance factors" (1973, p. 358). A visual analysis of the data (p. 359) indicated that the Animal House and Picture Completion subtests loaded the Verbal-Educational factor at the age four level.

One of the more recent studies of the WPPSI standardization data was reported by Mukherjee (1975). His reason for undertaking the study was stated:

> To examine the possibility of age related trends in the pattern of mental abilities. . . . The WPPSI data were factored . . . and three factors were retained for rotation by the equimax method. (Mukherjee, 1975, p. 214)

Mukherjee found an unrotated factor which he interpreted as a general intelligence factor. The first rotated factor was interpreted in terms of verbal intelligence because it was highly loaded by all WPPSI verbal subtests. The second rotated factor was labelled space performance because of the high loadings of the WPPSI performance subtests. Mukherjee described a Comprehension factor at the four year, six month and the five year age levels. At these age levels the Information, Vocabulary, Arithmetic and Picture Completion subtests loaded on the Comprehension factor. A visual analysis of Mukherjee's data indicated that the Arithmetic subtest loaded on each of the primary factors throughout the age range of the sample. In addition, the Animal House and Picture Completion subtests loaded heavily on the verbal factor at the four year age level.

The similarity of the results in each of the three studies is remarkable. Although the WPPSI standardization sample was used in each study, the factor structure of the WPPSI remained constant despite the use of different factor analytic methods. In addition, the same subtests were grouped on each factor. From highest to lowest the

Comprehension, Similarities, Information and Vocabulary subtests loaded on the verbal factor reported in each of the studies while the Geometric Design, Mazes and Block Design subtests loaded on a spatial or performance factor.

No trends were evident in the WPPSI data reported by Hollenback and Kaufman (1973), Wallbrown, Blaha and Wherry (1973) or Mukherjee (1975) concerning the Freedom From Distractibility factor as identified by Kaufman (1975) in the WISC-R data. In the two factor solutions by Hollenback and Kaufman (1973) and Wallbrown, Blaha and Wherry (1973), the WPPSI Arithmetic, Sentences and Animal House subtests had the lowest overall factor loadings. Even with Mukherjee's three factor solution, no general memory factor was discernible in the data. In Mukherjee's data, the three subtests possibly associated with memory had the lowest factor loadings at the youngest ages. However, in Mukherjee's data (p. 217), the WPPSI Arithmetic, Sentences and Animal House subtests loaded significantly on a third factor at the six year and the six year six month age levels.

Hollenback and Kaufman (1973), Wallbrown, Blaha and Wherry (1973) and Mukherjee (1975) reported factor analytic results using data from the 1967 WPPSI standardization sample. Like all test standardization and norming samples, the WPPSI group represented a large, so-called normal population. Results of WPPSI factor analytic studies of children from different cultural groups and socioeconomic levels were reported by Boyd (1970) and Krebs (1969) respectively. However, no studies of the factor analysis of WPPSI test results of children high risk for learning disability were located in the literature.

A comparison of the results from the WISC, WISC-R and WPPSI factor analytic studies just reviewed provides support for the organization of the WPPSI and the WISC-R into one general and two major scales. Subtests that measure language skills load on the verbal factor while subtests that measure visual motor skills load on the nonverbal factor reported in each study. However, at the younger age levels, i.e., four and five years, the WPPSI Picture Completion and Animal House performance subtests loaded both the verbal and nonverbal factors. While no evidence was presented in the WPPSI data to indicate that a Freedom From Distractibility factor existed, further research is necessary in order to determine whether young nonachieving children demonstrate this pattern. A comparison of the WPPSI subtest scores of atypical and achieving children could provide useful knowledge for use in student assessment. In the meantime, a review of reported diagnostic studies of the WISC and WISC-R provides useful data.

Review of Diagnostic Studies

As reported above, Bannatyne (1968, 1974) described a procedure for grouping WISC and WISC-R subtests into patterns for use in the assessment of learning disabled children. In response to findings by Rugel (1974), Bannatyne (1974) described a recategorization of WISC-R subtest patterns. The WISC-R subtests in each of Bannatyne's patterns were those previously identified in factor analytic studies as loading three factors (e.g., Verbal Comprehension, Perceptual Organization and Freedom From Distractibility). Bannatyne's Spatial Category included the Picture Completion, Block Design and Object Assembly subtests. The Conceptualization Category included the Comprehension, Similarities and Vocabulary subtests while the Sequencing Category includes the Coding, Digit Span and Picture Arrangement subtests. The Information, Arithmetic and Vocabulary subtests formed an Acquired Information Category. Subtest scores were used to describe each category in quantitative terms; i.e., the subtest scores in each category were averaged and used to compare patterns of intellectual functioning.

Reported studies indicate that significant research effort has been expended to validate Bannatyne's subtest categorization. Researchers such as Rugel (1974) and Mosely (1978) cited the results of the factor analyses by Cohen (1959) and Kaufman (1975) to support the choice of the subtests comprising Bannatyne's categories. The concerns of authors such as Rugel (1974) over the underlying factor structure of the WISC and WISC-R appeared to be minimal. More concern, as indicated by the number of reported studies, appeared to be directed toward finding patterns of intellectual functioning characteristic of children in each of several clinical groups. The genesis of this research thrust appeared to be related to reports by Bannatyne (1974, 1968) that reading disabled students as a group scored highest on the Spatial Category, at a moderate level on the Conceptual Category, and lowest on the Sequential Category. A search for patterns of WISC and WISC-R Categories characteristic of groups such as the learning disabled, emotionally disturbed and intellectually handicapped, resulted as one consequence to Bannatyne's work.

Bortner and Birch (1969) reported a factor analysis of WISC subtest scores of the original standardization sample and of identified samples of brain damaged and emotionally disturbed children. According to Bortner and Birch, the two special groups provided information ". . . to identify underlying patterns of psychological functioning of children with learning problems" (1969, p. 351). The authors described three factors (e.g., verbal, spatial-performance, distractibility) for each of the three groups; for each group the subtests in Bannatyne's Conceptual and Spatial categories loaded highest on the verbal and spatial factors respectively. However, the Digit Span and Coding subtests of the handicapped children loaded higher on the distractibility factor as compared to the normal group. Baumeister and Bartlett (1962) also reported a third factor analysis of the WISC scores of retarded children. While the results of the two studies demonstrate a pattern of distractibility for groups of atypical children, the results of a more recent study were contradictory.

Van Hagen and Kaufman (1975) compared the WISC-R results of eighty intellectually handicapped youngsters with results obtained from an earlier study by Kaufman (1975) that included intellectually average subjects. Van Hagen and Kaufman concluded that ". . . there do not seem to be important qualitative differences in the structure [of the WISC-R] for retardates and normals" (1975, p. 665). The evidence to support the use of Bannatyne's categorization in the differentiation of clinical groups other than the learning disabled appeared to be inconclusive. However, empirical support for the use of Bannatyne's categories to identify the intellectual characteristics of learning disabled children was available.

Rugel (1974) presented an analysis of 27 published reports of disabled readers in which WISC subtest scores were available. After recategorizing the WISC subtest scores and rank ordering the categories, Rugel (1974) concluded that as a group ". . . disabled readers received their highest scores on the Spatial Category, intermediate scores on the Conceptual Category and lowest scores on the Sequential Category" (1974, p. 61). The reported pattern in Rugel's study was the same as that reported by Bannatyne (1974) for problem readers.

Rugel (1974) also compared the patterns of the disabled readers to the patterns obtained by normal readers. He reported that most of the disabled readers had a strength in the visuo-spatial area as indicated by a relatively higher score in the Spatial Category. Rugel concluded that his analysis was ". . . based on group means and revealed differences between normal readers and a heterogeneous category of disabled readers" (1974, p. 54). In recognizing the heterogeneity of the groups of disabled readers, Rugel acknowledged the importance of identifying subgroups of reading disabled children.

An earlier study by Neville (1961) of the WISC responses of matched groups of male retarded and nonretarded readers supported the finding reported by Rugel (1974). Neville (1961) reported that retarded readers scored significantly lower on the WISC Digit Span and Arithmetic subtests as compared to scores on the Block Design subtest. In a later study, Feeler (1975) concluded that reading disabled children scored significantly lower on WISC-R verbal subtests as compared to performance subtests. The results reported in the studies by Neville and Feeler provided additional support for Rugel's conclusion that, as a group, reading disabled children were characterized by a distinctive pattern of WISC subtest scores, i.e., low verbal and relatively high nonverbal scores. Bannatyne's categories appeared to have validity and promise for use in identifying a subgroup of problem readers.

Miller (1976) used Bannatyne's categories in order

> . . . to determine which of the three subtest patterns best discriminated between children who had learning disabilities in visual perception and those who had learning disabilities in auditory perception. (p. 5747)

Miller reported that Bannatyne's categories differentiated the children who had been previously diagnosed and placed in the two dysfunctional groups. However, Miller's conclusion was that while the categories were useful in classifying 80% of the children with visual perceptual problems, each category was effective in classifying only 40% of the children with auditory perceptual problems. The hazards of misclassifying and, as a result, misplacing students were demonstrated in the results reported by Miller (1976).

In recent years, a new line of research enquiry has sought to provide answers to questions concerning the efficacy of using Bannatyne's categories to make differential diagnosis and placement decisions. The methodology employed in this type of research has been similar. Groups of children with prediagnosed handicaps (e.g., learning disability, educable mentally handicap and emotional impairment) were administered either the WISC or the WISC-R. Discriminant functions analyses were then employed to predict group membership using Bannatyne's categories as the predictor variables.

Clarizio and Bernard (1981), Hughs (1977) and Thompson (1981) have employed the methods described in order to predict group membership using a WISC-R subtest categorization (Bannatyne, 1974). As a group, these researchers have reported that the categories do not effectively predict the group membership of atypical children and, in their respective studies, they advance cautions over the use of Bannatyne's categories alone for differential diagnosis. The danger of misclassification of students was illustrated by a statement by Clarizio and Bernard (1981): "A three-factor WISC-R profile is not effective in differential diagnosis" (1981, p. 11). Moreover, a problem of interpreting the scores of individuals from group scores was illustrated in these studies. Again, Clarizio and Bernard's conclusion was representative: "Learning disabled children represent too heterogeneous a group to expect one characteristic to be typical of all or even most of them" (1981, p. 11). Other researchers have reported the results of studies in which homogeneous subgroups of learning disabled children were formed.

In an extensive study, Fuller and Friedrick (1974) delineated the behavioral and academic correlates of subgroups of reading disabled children in Grade Four. In the study, Fuller and Friedrick initially formed three subgroups based on student responses to the Minnesota Perceptio-Diagnostic Test. The children in group one (Primary Reading Retarded), group two (Secondary Reading Retarded) and group three (Reading Retardation Associated with Brain Damage) were then administered a battery of five tests including the WISC. According to Fuller and Friedrick ". . . the results of the testing program clearly supported the concept that three subgroups of readers do have a number of unique behavioral characteristics" (1974, p. 7).

One of the stated purposes of the study by Fuller and Friedrick (1974) was ". . . to use a systematic approach in evaluating the utility of establishing reading disability subgroups (delineating the heterogeneity assumption)" (1974, p. 6). In achieving this objective, Fuller and Friedrick presented data to refute the Spatial-Conceptual-Sequential WISC pattern reported by Bannatyne (1974) for disabled readers. Data were presented to illustrate differences in the rank ordering of Bannatyne's subtest categories for each of the three reading subgroups. The results reported by Fuller and Friedrick (1974) suggested that Bannatyne's three-factor categorization was not descriptive of each subgroup. However, an analysis of the reported data for each subgroup illustrated a congruence between the order of Bannatyne's categories with the diagnostic profile reported by Fuller and Friedrick (1974) for each subgroup. It appeared that when considered with other diagnostic information, Bannatyne's categorization correlated highly with profiles of abilities and deficits. Bannatyne's categories appeared to have potential use as a guide for further diagnostic work with children with reading disabilities.

In a more recent study, Vance, Wallbrown and Blaha (1978) suggested that the search for identifiable patterns of WISC and WISC-R scores for reading disabled students was disappointing. Referring to existing studies they claimed: "There are not, so far as the authors can determine, any characteristic WISC patterns which single children with learning disabilities out of a school population" (Vance, Wallbrown, & Blaha, 1978, p. 55). These authors also claimed that ". . . at this point research should be directed toward defining the possible significance of differences in WISC scores rather than toward pattern identification which seems relatively useless" (Vance, Wallbrown & Blaha, 1978, p. 55). Vance and his colleagues concluded that research should be directed toward investigating the implications that WISC subtests have for the reading process. In other words, the instructional implications of WISC profiles were important considerations.

As a result, Vance, Wallbrown and Blaha (1978) identified subgroups of reading disabled students.

Vance, Wallbrown and Blaha (1978) employed a Q technique of factor analysis rather than the standard R technique employed by researchers such as Kaufman (1975). Vance and his colleagues used the Q technique of factor analysis to investigate the similarities among the WISC-R profiles of 104 reading disabled students. The researchers placed emphasis on the analysis of the profiles of individual students rather than intercorrelations among test scores. In response to criticism by Miller (1980), Wallbrown, Blaha and Vance (1980) stated:

> We chose to use a Q-analysis for the (1978) study because our interest was to determine the extent to which reading disabled children could be classified in syndromes on the basis of similarities in the shape of their WISC-R profiles. (p. 55)

Vance, Wallbrown and Blaha (1978) obtained five meaningful WISC-R profiles by use of the Q technique. They reported that 75% of the children in the sample could be assigned to one of five primary syndromes. The authors defined a primary syndrome: "The factor (or profile) on which the child's profile loaded highest" (Vance, Wallbrown & Blaha, 1978, p. 57). The syndromes were called: Distractibility, Perceptual Organization, Language Disability-Automatic, Language Disability-Pervasive and Behavioral Comprehension and Coding. In a later report, Wallbrown, Vance and Blaha (1979) discussed how the five WISC-R profiles were used to develop remedial strategies for reading disabled children. In another report the authors were careful to state that their WISC-R profiles were not faultless in classifying all children; however, the five profiles were recommended for use in generating remedial hypotheses (Wallbrown, Vance & Blaha, 1980, p. 58).

Doerhing and Hoshko (1977) also used the Q technique of factor analysis to classify two groups of reading disabled children into homogeneous subgroups. Doerhing and Hoshko summarized the study:

> The Q technique of factor analysis was used to define subtypes of reading problems in terms of performance on 31 tests of rapid reading skills. . . . Three subgroups were identified within each group by the statistical classification procedure. (1977, p. 293)

The study by Doerhing and Hoshko was similar to the study reported by Vance, Wallbrown and Blaha (1978) in that children from a reading disabled group were classified into homogeneous subgroups by the use of the Q technique of factor analysis. In both studies, subgroup classifications were made and then descriptions were made of the cognitive and perceptual correlates of each subgroup. In addition, the authors used their subgroup profiles to generate remedial hypotheses and to plan remedial interventions.

Several conclusions can be drawn from the studies of Vance, Wallbrown and Blaha (1980, 1979, 1978) and Doerhing and Hoshko (1977).

First, the Q technique of factor analysis appears to be a promising technique to use in overcoming problems created by the heterogeneity-homogeneity issue. A Q factor analysis of the test scores of children provides a means to identify subgroups of children with specific learning disabilities. Moreover, a classification of children into homogeneous subgroups with known deficits provides an effective method to generate remedial hypotheses and to plan interventions. Finally, in the study by Vance and his colleagues (1978), the WISC-R subtest patterns for the primary syndromes are similar to the pattern of WISC subtests included in the categories reported by Bannatyne (1974, 1968). Certainly, the research of profile analyses and patterns of intellectual skills will continue. How well have patterns of intellectual skills from the WPPSI identified young learning disabled children? Few studies exist in order to answer the question.

Hagin, Silver and Corwin (1971) reported the results of a comprehensive study in which children were assigned to either a normal or at risk group at the beginning of Grade One on the basis of kindergarten achievement and neurological examination. The WPPSI was administered to the children in both groups and the results were compared. A comparison of the WPPSI IQ and subtest scores for each sample group indicated that the at risk group had significantly lower scores than the normal children. Moreover, no consistent pattern of verbal and performance IQ scores was found to characterize the two groups. In addition, the researchers reported: "No consistent subtest pattern was found to characterize the intervention group" (Hagin, Silver &

Corwin, 1971, p. 225).

The problem encountered by Hagin and her coresearchers is similar to the problem previously discussed concerning the use of categories of WISC-Rscores (Bannatyne, 1974) to identify learning disabled children. However, Hagin, Silver and Corwin reported: "The picture becomes clearer when the findings on the WPPSI are related to the three diagnostic subgroups that we find comprising the intervention group" (1971, p. 227). Hagin and her coresearchers described unique WPPSI subtest score profiles for the children in each subgroup, i.e., specific language disability, organics and developmentally immature. Hagin, Silver and Corwin concluded from the study:

> The qualitative and quantitative material elicited by the WPPSI was useful in the selection and diagnostic processes. . . . It appears inadvisable to assume that learning disability is a homogeneous condition manifesting itself in any characteristic cognitive pattern. (1971, p. 230)

The study by Hagin and her colleagues is described in length because it was one of the few diagnostic studies of the WPPSI reported in the literature. These coresearchers recognize the usefulness of profiles of WPPSI scores to identify potential areas of learning dysfunction. Like researchers such as Fuller and Friedrick (1975), Hagin and her colleagues acknowledge that learning disabled children as a group are heterogeneous. In addition, by identifying homogeneous subgroups of children with specific learning problems the efficacy of intervention is enhanced.

Efficacy of Screening Tests

Emphasis on the prediction of learning problems prior to the time a child begins school has raised new questions in the area of assessment. Keogh (1977) stated, "Pre-school and early kindergarten screening or early identification is essentially a predictive activity" (p. 268). Colarusso, Plankenhorn and Brooks (1980) supported Keogh's statement: "To identify a child with a potential learning problem at an early age is to hypothesize rather than to confirm the possibility of later failure" (p. 355). Problems of predictive validity exist. Can one predict the later school learning failures of children assessed in kindergarten? What is the most effective method of predicting these failures? There was insufficient research to provide clear answers to these questions.

The prediction of learning problems for kindergarten-aged children is made difficult by the lack of agreement among researchers concerning the relationship between predictor and criterion variables. For example, Eaves, Kendall and Crichton (1974) reported a three year follow-up study of 163 kindergarten children in which 196 variables were used to predict achievement at the end of Grade One and Grade Two. Eaves and his colleagues concluded their study by stating:

> We simply do not know enough about the psychological processes involved in learning to read and write to explain our findings . . . in terms of specific relationships between earlier performance on motor, perceptual

and language tasks and later progress in reading skills. (Eaves, Kendall & Crichton, 1974, p. 48).

The literature on screening and early identification procedures, on the other hand, contains studies that support the notion that accurate prediction of school learning problems is possible. Different procedures were used in studies involving the prediction of learning problems. Researchers such as Feshback, Adelman and Fuller (1974) supported the use of kindergarten teacher checklists to identify and to predict children who may have learning problems. The results of this type of interactional study are encouraging, but the studies are few in number. The use of psychometric tests to determine what variables predict future school success and failure has received greater attention in the literature.

In follow-up studies, researchers such as Colarusso, Plankenhorn and Brooks (1980) and Satz and Friel (1978) used multivariable predictors of school achievement. Satz and Friel used a battery of tests that measured skills such as visual-motor integration, listening vocabulary, digit recall and letter naming; the authors were able to predict with 90% accuracy the learning problems of children over a three year period. Positive results were reported by Colarusso and his colleagues in a similar three year follow-up study. However, these researchers reported that the use of single variable predictors, such as IQ or perceptual motor skills, could not be relied upon to accurately predict potential learning problems.

The results of the studies concerning the prediction of school learning problems just reviewed indicate that kindergarten children with potential learning problems can be identified and their school learning problems predicted with varying degrees of accuracy. Moreover, the relationships between specific predictor and criterion variables have obvious importance for educational intervention. Other researchers have addressed the problem of determining the relationship between predictor and criterion variables in educational terms.

Book (1974) reported a three year follow-up study of 725 kindergarten children. Book stated that his purpose was to:

> . . . formulate a predictive index for reading difficulties which would be economical in terms of time and money and which would answer specific questions concerning a child's development. (1974, p. 52)

Book used the Slosson Intelligence Test, Metropolitan Readiness Test and the Bender-Gestalt Test to establish criteria in order to place kindergarten children into one of six intervention groups. During the Grade One year, each intervention group of children had access to extended readiness and remedial programs. Although Book did not provide a description of remedial activities, he reported a significant correlation (.99) between the end of first and second grade reading achievement and the diagnostic category to which a child was originally assigned. In the study, Book accurately predicted the school success or failure of children in diagnostic subgroups over a one to three year period.

Keogh and Becker (1973) discussed issues concerning the identification of young children considered to be educationally at risk. These authors presented arguments that screening test information be gathered in order to plan educational intervention rather than simply to classify children. In a later report, Keogh (1977) suggested that predictive efficiency was enhanced by shortening the time interval and specifying the relationship between predictor and criterion variables. "Predictive validity is increased when predictors are made to outcomes which are close in time and which are directly related to the particular programs in which the child will be placed" (Keogh, 1977, p. 269).

Book (1974) operationalized the suggestions made by Keogh and Becker (1973). By selecting test instruments which reflected a kindergarten child's level of functioning, Book (1974) was able to identify diagnostic subgroups of children and to accurately predict school success or failure over a short and intermediate time interval. Of special importance to the present investigation is the fact that Book chose tests of general intelligence, readiness and perceptual development to identify children for his study.

Conclusions

The research reviewed in this chapter provided some evidence to support several conclusions:

1. Factor analytic procedures are useful in determining patterns of WISC and WISC-R scores in groups of normal and atypical children.

2. The WISC-R subtest categorization of Bannatyne (1974, 1968) provides an effective method to determine areas of intellectual

dysfunction that can be used to develop remedial hypotheses.

3. The search for WISC and WISC-R subtest patterns that identify homogeneous groups of learning disabled children is a promising but inconclusive research area.

4. Profile or clustering techniques such as the Q technique of factor analysis are effective tools for identifying subgroups of learning disabled children.

5. As far as this researcher can determine, no factor analytic studies of WPPSI subtest scores of learning disabled students are reported in the literature.

6. Screening tests that reflect the functioning level of kindergarten children can be used to identify and to predict school learning problems.

7. Further research of screening procedures is necessary in order to facilitate the planning of diagnostic and remedial interventions for young children.

CHAPTER III

METHODS AND PROCEDURES

The present investigation was conducted in order to determine whether selected psychological tests hold promise for use in assessing the learning problems of young children. A battery of tests, including the Wechsler Preschool and Primary Scale of Intelligence (WPPSI), was administered to two groups of children. The WPPSI test data were analyzed to determine whether subtest score patterns emerged and whether the patterns were different for the two groups. Additional analyses were completed to determine whether any existing patterning was related to the daily functioning of the children as identified by screening procedures. A profiling technique was also used to determine whether homogeneous subgroups of children existed within the sample groups.

The sample population identified for the investigation included a control group of children who had no reported academic learning and behavior problems and a group of children thought to be educationally at risk for learning disability (see definitions on page 61). The children were selected from the 60 to 80 month age range. The children in the age range identified for the investigation were selected for two reasons: (a) they were attending kindergarten or Grade One; (b) because they were experiencing school activities for the first time, it was possible to select groups of young children who were both young and experiencing either success or failure with initial school experiences. The need for adequate tools to identify potential learning disabled children in the age range sampled was recognized and provided the rationale for the present investigation.

The line of enquiry followed in the present study appeared to be justified. The research reviewed in earlier chapters provided evidence to support the following statements:

1. Patterns of subtest scores on individually administered intelligence tests, that were discrepant with other subtest score patterns, provided useful data for identifying and diagnosing the problems of children at risk for school learning.

2. Few reports have been published that employed the WPPSI in factor analytic and diagnostic studies with young educationally at risk children.

3. Few researchers have described the relationship between WPPSI subtest score patterns and scores on screening tests.

4. Most existing preschool screening tests lacked validity data for use with potentially learning disabled children.

Selection Criteria For Subject Identification and Description of the Sample

Two groups of forty students were selected for the present investigation. A group identified as nonachieving and a group identified as achieving were selected from kindergarten and Grade One classes in the Grande Prairie area.

The children in the nonachieving group were identified on the basis of teacher referrals and written reports to the Grande Prairie Regional Office of Education Learning Assistance Centre (LAC) (See Student Referral Form, Appendix A). The reliability and predictive validity of teacher reports in the identification of young learning disabled was documented and continued in the present study (Colarusso, Mathis & Shessel, 1979; Cowgill, Friedland & Shapiro, 1973; Keogh, Tchir & Windeguth-Behng, 1974). The first 40 children referred for educational assessment in 1980-81 that met the following selection criteria were included in the nonachieving group:

1. The children selected were reported in writing by their teachers as having difficulty completing classroom tasks successfully performed by other children. In educational terms, the children referred for LAC assessment were identified as having one or more difficulties learning to listen, to express ideas orally, to copy, to read, to use numbers, to participate in classroom games and to establish peer relationships in the classroom and on the playground. The children in this group presented behavior problems such as short attention span that hindered effective learning and had difficulty with academic task completion despite adequate intellectual ability as indicated on the WPPSI.

2. Children with identified sensory impairment, trainable mental retardation, speech disorders and cultural deprivation were omitted from the study. The decision to exclude youngsters manifesting

any of these syndromes as the primary impairment was made with full recognition of the cross categorical movement in the field of learning disabilities. The decision was made in order to preclude the biasing effects on the test data of handicapping conditions that were not within the scope of the present study. Children of North American Indian ancestry were also excluded from the sample of nonachieving children. It was recognized that these children may also manifest learning disability. However, the scope of the present study was not extended to control for the effects of experiential and second language factors which might be complicating development for this group of children.

The 40 children in the regular achieving group were selected from the class lists of 14 kindergarten and Grade One classrooms in the Grande Prairie area. The names on each class list were randomly reordered to reduce any biasing effects of alphabetized class lists; the names were then assigned a number from 1 to 300. The names of the children in the achieving group were selected by using a table of random numbers (Newmark, 1977, p. 470). The parents of the children were then contacted by letter in order to obtain written consent for testing (see Appendices B & C). Out of a total of 56 letters sent to parents, 43 written consent forms were returned.

The children in the regular achieving group were reported by their teachers at time of testing as being successful and presenting no major learning problems in regular classroom task performance. Three of the children in the regular achieving group, however, were found at time of testing to have minor learning problems. In order to maintain the process of random selection, and to approximate normalcy, these children were not excluded from the regular achieving group. Their learning problems were not severe, so it was felt that any confounding effects would be minimal.

Lerner (1976) reported that more boys than girls are referred by teachers to diagnostic centres such as the LAC. Since no control existed over the students referred to the LAC, the traditional ratio of five boys referred to one girl was anticipated. Because the testing of the two groups was concurrent, the numbers of children in each group were matched on sex. The numbers of boys and girls in each sample group are listed in Table 1 together with a list of the numbers of children by age range and classroom placement. For the interested reader, information concerning the age, sex, IQ and residence of each subject is listed in Appendix F.

As reported in Table 1, there are seven more nonachieving than achieving children in the 73 to 78 month age range. The higher number of nonachieving children in this older age range resulted from the fact that three of the children were repeating their kindergarten programs. In addition, as demonstrated in Table 1 five more Grade One children were included in the nonachieving compared to the achieving group. The age variable was not expected to have a biasing effect on the data. Despite their relative older age, the children in the nonachieving group were expected to score below the achieving children on the tests used in the study.

Table 1

Number of Subjects in Two Groups According to Age Range, Sex and Classroom Placement

Variable	Achieving	Non-Achieving
Age Range		
60 - 66 months	13	10
67 - 72 months	19	15
73 - 78 months	8	15
Total	40	40
Sex		
Male	32	33
Female	8	7
Total	40	40
Classroom Placement		
ECS	32	27
Grade I	8	13
Total	40	40

Because of the difficulty in controlling the effects of a residence variable on the data, an operational definition of residence was made (see definitions on page 61). According to the definition, four of the achieving and five of the nonachieving children were considered to be urban residents while 36 and 35 of the children in the respective groups were considered to be rural residents. The children in the sample groups, therefore, were similar in terms of place of residence.

Because of difficulties encountered in obtaining accurate occupational information, the effects of socioeconomic status were not controlled in the study. It was felt that the lack of information on the occupational status of parents would not present a major problem in analyzing the data or generalizing the results. Backman (1972) reported that the relationships between socioeconomic, sex and intellectual variables were too weak for meaningful interpretation. The SES of the parents was not considered to be a major confounding variable in the study.

The sample groups in the present study were not matched for IQ level or range. Although writers such as Torgesen and Rice (1980) were critical of such research practices, other writers provided evidence in support of the procedures used in the present study. Recent reports documented the point that learning disabled children score lower than normal achieving school children, and in many cases, score below average on intelligence tests (Gajar, 1979; Smith, Coleman, Dokecki & Davis, 1977). The concept of normality of IQ was questioned in these reports as a valid criterion in the identification of learning disabled children. Furthermore, writers such as Garrison and Hammill (1971) and Eno and Woehkle (1980) raised the issue that many children diagnosed as educable mentally handicapped (EMH) were misplaced when IQ criteria alone are considered. In short, many EMH children scored below average IQ scores, but their diagnostic profiles were similar to learning disabled children with IQ scores in the normal range.

Several children in the at risk group in the present study scored below average IQ scores. A decision was made to include these children in the study because each of the children were reported by their teachers as making progress in one or more academic or developmental areas. Vindication for this decision was expected, particularly if this subgroup of children had similar WPPSI subtest score patterns as the other children in the at risk group.

As expected, a difference existed between the two groups of children in terms of IQ scores. As a group, the nonachieving children had average full scale and performance IQ scores and a below average verbal IQ, i.e., respective mean scores of 92, 96 and 89. The respective mean full scale, performance and verbal IQ scores for the achieving children were 105, 104 and 105. The mean WPPSI verbal and performance subtest scores for the sample groups are presented in Figure 1 .

The Test Battery

Four standardized tests and one behavior rating scale were selected to obtain the psychometric data for the purposes of the present study. Three of the standardized tests were screening measures; the other was an individually administered intelligence test.

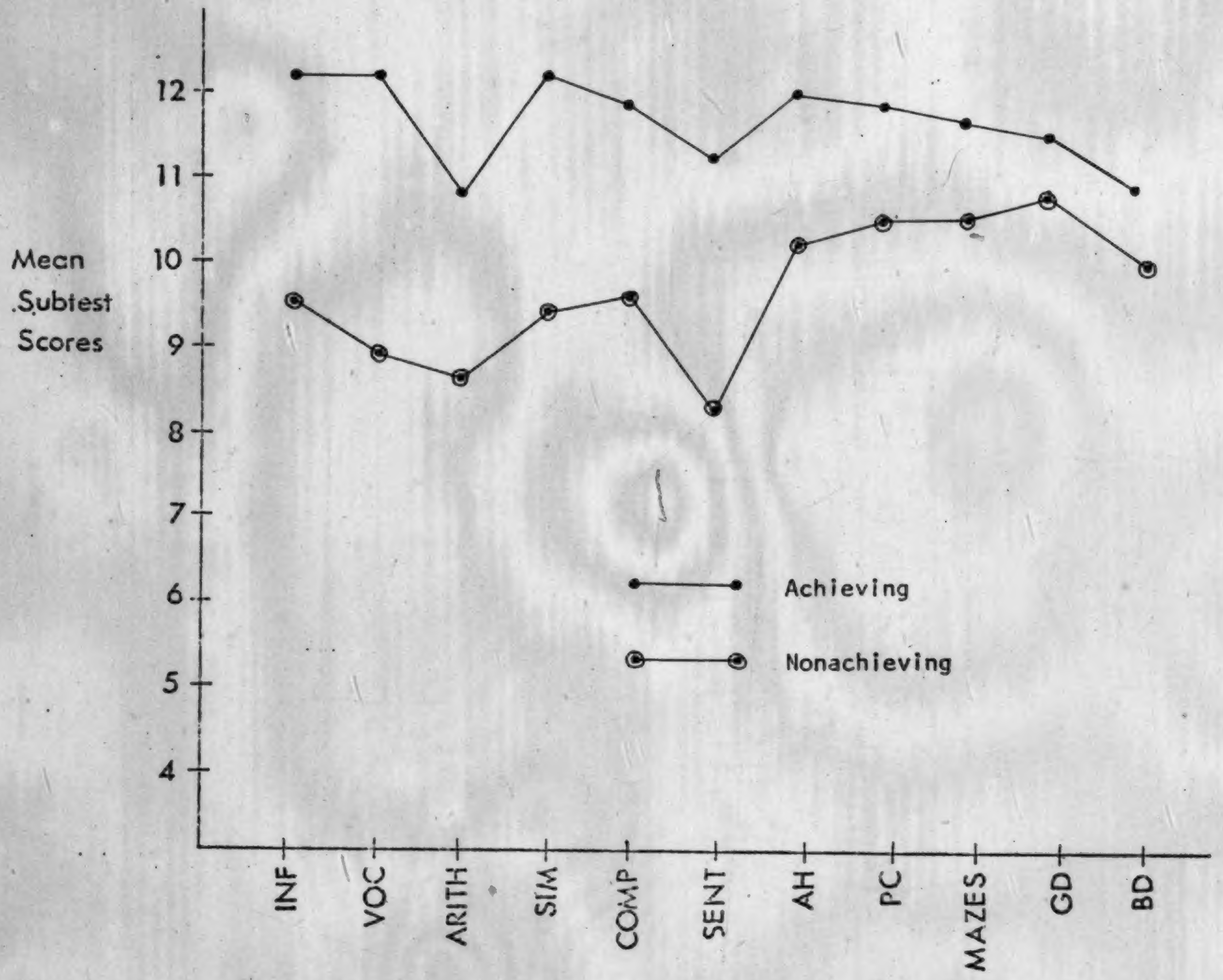

Figure 1. Mean verbal and performance WPPSI subtest scores for achieving and nonachieving subjects.

The three screening tests were selected because they were reported by McCarthy and Lund (1978) to be the most efficient tests available on the market in terms of administration and scoring time and in ease of interpretation. In addition, the tests were chosen because they measured skills important to success in school. Two of the tests were designed as measures of school readiness; the other was a diagnostic test of learning problems. The three individually administered, power tests appeared to have good time utility for teacher use in screening students with learning problems. The authors of each test reported that their test tapped skills that were predictive of school learning problems. The screening tests provided additional variables to which patterns of intellectual subtest scores were compared.

The following screening tests were selected for the study:

1. ABC Inventory to Determine Kindergarten and School Readiness (Adair & Blesch, 1965).

2. Dallas Pre-school Screening Test (Percival & Paxon, 1978).

3. Anton Brenner Developmental Gestalt Test of School Readiness (Brenner, 1964).

The ABC Inventory to Determine Kindergarten and School Readiness (ABC) was designed to ". . . identify children who are immature for a standard school program" (Adair & Blesch, 1965, p. 3). Although primarily intended as a school readiness measure, the ABC was included in the study because administration time averaged only eight minutes and because the four sections of the inventory tapped skills that could predict language and perceptual learning problems of children in the five to six year age range. The ABC was successfully used by Lesiak and Wait (1977) to identify children with learning difficulties. Validity information on the ABC was not reported in the literature.

The ABC consisted of items divided into four sections. A total raw score was compiled by adding the scores from the four sections; scores were then transformed into a readiness age score by referring to the norms illustrated on each test protocol. The ABC contained the following sections:

1. Section 1. In this section the child drew a man and was scored on the presence of body image detail.

2. Section 2. Questions were presented about the characteristics of objects. Simple facts such as colors and seasons of the year were tested in this section.

3. Section 3. The child was required to answer questions about general topics such as, "What is ice when it melts?"

4. Section 4. Four tasks were presented that required the child to count, to fold a paper triangle, to recall four digits and to copy a square. Perceptual skills were tapped in this section.

The Dallas Pre-school Screening Test (Dallas) (Percival & Paxon, 1978) was designed to screen five primary learning areas of children in the three to six year age range. According to the authors, the Dallas ". . . may be administered in fifteen to twenty minutes . . . it includes most related parameters of childhood learning and development" (Percival & Paxon, 1978, p. 8). In a recent evaluation, Hale and Metzler (in McCarthy & Lund, 1978) reported that the Dallas had good reliability and time utility in identifying learning disabilities in five year old children. Lambert (1980) reported that the Dallas had good concurrent validity (r = .70) with the Metropolitan Readiness Test. She also reported (personal correspondence) that the Dallas had good test-retest reliability (r = .81). The Dallas was used in the present study because it had demonstrated utility and reliability and it measured skills that were of use in the identification and the diagnosis of children with learning deficits.

Dallas raw scores were tallied for each of the following learning areas:

1. Psychological. Included in the four subtests in this general learning area were items that assessed ". . . communication both receptive and expressive, vocabulary and number concepts and auditory discrimination" (Percival & Paxon, 1978, p. 7).

2. Auditory. "The Auditory developmental evaluation [included] fine discrimination, perceptiveness and memory" (Percival & Paxon, 1978, p. 8).

3. Visual. "Visual skills [were] screened via paper and pencil tasks, coloring, color discrimination and matching geometric designs" (Percival & Paxon, 1978, p. 8).

4. Language. Receptive language and word defining tasks were presented in the three subtests in this learning area.

5. Motor. "Motor development [was] evaluated by gross and fine motor assessment" (Percival & Paxon, 1978, p. 8).

The Anton Brenner Developmental Gestalt Test of School Readiness (BGT) (Brenner, 1964) was selected as a valid readiness test for the age range sampled in the present study. According to Brenner (1964) and Wells (1976) the BGT was designed to assess perceptual-conceptual development in children and to predict number and reading readiness. Brenner claimed, "The BGT is most predictive when used with children of 5 years and 6 years" (1964, p. 5). Wells stated, "The BGT is one of the few readiness measures that research has shown to be an effective predictor of school achievement" (1976, p. 1). BGT subtests required the use of visual, conceptual and motor skills that were predictive of specific learning disabilities. The decision to include the BGT in the present study appeared to be justified. The five BGT subtests administered were:

1. Number Producing. The student was required in separate trials to place three, then five blocks in the examiner's hand and then to express the total number held by the examiner.

2. Number Recognition. The child was required to state the total number of black dots in different sized groups as the groups were indicated.

3. Ten Dot Gestalt. The child copied a rectangular shaped array of black dots.

4. Sentence Gestalt. The child copied a three word sentence.

5. Draw A Man. The child was required to draw a human figure.

The Wechsler Pre-school and Primary Scale of Intelligence (Wechsler, 1967) was selected for use in the study because it was reported by Sattler (1974) as a valid measure of the intellectual abilities of the children in the 4 to 6 year age range. The division of the test into two groups of subtests purportedly measuring language and nonverbal skills ". . . has proven diagnostically useful . . . [in] alerting the examiner to the manner or degree to which a subject's assets and liabilities may influence his overall functioning" (Wechsler, 1967, p. 2). Although time-consuming in both administration and scoring, the WPPSI was reported by Sattler (1974) as one of the better individual intelligence tests available in terms of test validity, clinical use and as holding promise in assisting the planning of special education programs. One of the central questions in the present study was to assess the power of the WPPSI to differentiate the achieving and the nonachieving children. The content of each WPPSI verbal subtest is described as follows:

Information. "This subtest taps a broad spectrum of knowledge" (Carlson, 1973, Sect. 120.01). The item content of this subtest is similar to the content of section 2 of the ABC Inventory. Items such as "What is the color of grass?" are contained in the WPPSI subtest while questions such as "What has wings?" or "Tell me the color of an apple" are contained in the ABC.

Vocabulary. "The test requires that the child verbally express the meaning of words" (Carlson, 1973, Sect. 120.01). Similar skills were required to complete the language subtests of the Dallas. For example, in the WPPSI subtest children are required to define words such as hat or nail and to answer questions such as "What swims?" or "What explodes?" on the Dallas.

Arithmetic. "This test is an attempt to tap the kinds of functions which underlie mathematical thinking. . . . No paper and pencil are used" (Carlson, 1973, Sect. 120.01). The child is required to count objects in serial order and in groups. Subtest 1 of the BGT and one subtest from section 4 of the ABC required similar skills. For example, on the ABC the child counts squares and on the BGT he is required to count blocks in groups of 3, 5 and 8.

Similarities. The child is required to complete ". . . analogy-like sentence completion items such as 'A cat says meow and a dog says . . . .'" (Carlson, 1973, Sect. 120.01). Skills required to complete section 3 of the ABC are similar to the skills required to complete the Similarities subtest. For example, on the ABC a child is required to answer items such as "What is ice when it melts?"

Comprehension. The child was required to respond to ". . . problem situations similar to real life" (Carlson, 1973, Sect. 120.01). The screening tests administered in the study did not contain any subtest similar in format to the Comprehension subtest.

Sentences. "The child is required to repeat sentences verbatim" (Carlson, 1973, Sect. 120.01). Item content of the auditory section of the Dallas is similar to the content of the Sentences subtest. For example, on the Dallas a child repeats sentences such as "I am a girl" or "See the little cat playing with the big red ball."

Five nonverbal subtests are included in the performance section of the WPPSI. The content of each WPPSI performance subtest is described as follows:

Animal House.

> The child is presented with a board which has rows of pictures of animals. . . . Each one [picture] has a hole below it into which a small colored cylinder may be placed. . . . The child is asked to match cylinders to animals" (Carlson, 1973, Sect. 120-01)

BGT subtests 2 and 3 were similar to the Animal House subtest in that visual memory and sequencing skills were required to draw a rectangular array of dots and to copy a sentence.

Picture Completion. "Line drawn pictures in which some essential item is missing are the materials for this test. . . . The child is required to indicate . . . what is missing" (Carlson, 1973, Sect. 120-01). The content of the Dallas visual subtests was similar to that of the Picture Completion subtest. In the Dallas test a child is required to use visual discrimination skills to match geometric symbols.

Mazes. "The testee is to draw a line through a pathway without erring or entering a blind alley" (Carlson, 1973, Sect. 120-01). Items from one Dallas subtest resembled the content of the Mazes subtest to the extent that they both required a child to use fine motor skills. For example, on the Dallas, a child is required to color a ball, i.e., a circle. Other than that no other test required the same skills as those required by the Mazes subtest.

Geometric Design. "The test materials are ten geometric forms. . . . The child is to copy the printed forms . . . onto the sheets of paper provided" (Carlson, 1973, Sect. 120-01). Items in question 7 of the Dallas visual section contained similar stimulus figures used in the Geometric Design subtest. On the Dallas test a child was required to copy the geometric symbols in the same way as on the Geometric Design subtest.

Block Design. "The child is required to duplicate patterns with colored, square chips" (Carlson, 1973, Sect. 120-01). The BGT Ten Dot and Sentence Gestalt subtests also required visual-motor skills similar to those required to complete the Block Design subtest in that both required the child to reproduce a pattern.

The final measure used in the study was the Davids Rating Scale for Hyperkinesis (Davids, 1971). In the study, teachers completed the scale by rating each child on each of six traits; each trait was evaluated on a one to six point scale (see Appendix D). An objective measure of the classroom behavioral problems manifested by educationally at risk children was required to describe and to select the nonachieving children; the Davids was selected. The behavioral traits on the Davids were similar to those characteristics identified by Clements (1968) as being characteristic of learning disabled children. Little information on the concurrent validity of the measure existed, but the scale provided an objective means for the teachers to judge the behavioral characteristics of both groups of children sampled in the study.

The following traits, as described on the scale, were rated by teachers for each child:

1. Hyperactivity. Involuntary and constant overactivity.

2. Short Attention Span. Concentration on a single activity is usually short.

3. Variability. Behavior is unpredictable with wide fluctuations in performance.

4. Impulsiveness. Does things on the spur of the moment without thinking.

5. Irritability. Frustration tolerance is low; frequently in an ugly mood.

6. Explosiveness. Fits of anger are easily provoked.

In summary, 38 test variables were included for investigation in the study. They are:

I. WPPSI subtest and IQ scores
   1. Information
   2. Vocabulary
   3. Arithmetic
   4. Similarities
   5. Comprehension
   6. Sentences
   7. Animal House
   8. Picture Completion
   9. Mazes
   10. Geometric Design
   11. Block Design
   12. Verbal IQ
   13. Performance IQ

14. Full Scale IQ

II. ABC Inventory

15. Draw A Man

16. Facts

17. Conception

18. Perception

19. ABC total score

III. Dallas Screening Test

20. Psychological

21. Auditory

22. Visual

23. Language

24. Motor

25. Dallas total score

IV. Brenner Gestalt Test

26. Number Producing

27. Number Recognition

28. Ten Dot Gestalt

29. Sentence Gestalt

30. Draw A Man

31. Brenner total score

V. Davids Hyperkinesis Scale

32. Hyperactivity

33. Short Attention Span

34. Variability

35. Impulsiveness
36. Irritability
37. Explosiveness
38. Davids total score

Procedure

Each measure in the test battery excluding the Davids was individually administered by the author to all children selected for the study. The teacher, after consultation with the author, completed the Davids. The children in the nonachieving group were tested by the author as part of his responsibilities as a member of the Learning Assistance Centre. The children in the achieving group were tested during a regular kindergarten or school day after written, parent consent was received. All examinee responses were recorded on the test protocols.

The tests were administered in the following order to the children in both groups:

1. ABC Inventory
2. Dallas Screening Test
3. Brenner Gestalt Test
4. Wechsler Pre-school and Primary Scale of Intelligence

All sections of the ABC and the BGT were administered to the children in both groups. With one exception, all of the Dallas subtests were administered. The Dallas articulation subtest was dropped in order to reduce testing time and because the screening of specific speech disorders was beyond the scope of the present investigation. In order to provide as wide a data base as possible, the eleven WPPSI subtests were administered. Although the WPPSI Sentences subtest was not used in computing the WPPSI IQ scores, it was administered to find possible group differences in the completion of the subtest. Normally, the WPPSI Animal House subtest is administered twice. In order to reduce testing time, the second Animal House subtest was not administered; this decision appeared to be justifiable because the subtest score was not used to compute WPPSI IQ scores.

The complete test battery was administered to the children in both groups whenever possible on the same day. Where rapport was not easily established or examinee fatigue was evident, testing was discontinued and completed in a follow-up session. The teachers of the children tested completed Davids Hyperkinesis Scale during the first test session. Once each child was tested, the psychometric data were compiled on individual data sheets (see Appendix E).

Questions for Investigation

The present study was designed to investigate the following questions:

1. Do factors emerge for the achieving and nonachieving groups in factor analyses of the WPPSI subtest scores?
2. If factors do emerge for the WPPSI, will the factors be similar for the achieving and nonachieving groups?
3. If factors emerge for the WPPSI, are they similar to the factors on the WISC-R as identified by other researchers, e.g., Kaufman (1975)?

4. Will the WPPSI subtests loading the factors for the achieving and nonachieving groups be similar to the WISC-R patterns as identified by researchers such as Bannatyne (1974)?

5. Will subtest scores on the WPPSI correlate significantly with performance as assessed by the screening measures used?

6. Do children in the sample groups sort out into subgroups that are characterized by different patterns of functioning?

Analysis of Data

Several statistical procedures were used to analyze the data in this investigation:

1. The Statistical Package for the Social Sciences (SPSS) available through the Division of Educational Research Services (DERS) was used to obtain descriptive statistics. Statistics of central tendancy (i.e., mean, range and standard deviation) were obtained for each of the variables investigated in the study. In addition, two tests of significance were computed: F tests on variances and t tests on means. Because Ferguson (1976) claimed that ". . . variances obtained in any experiment should always be the subject of scrutiny and study" (p. 178), a homogeneity of variance test was completed for each variable under investigation. Where a homogeneity of variance assumption for parametric statistics was not met, a t value based on a separate variance estimate was used to determine the level of significance of the mean test scores for the sample groups.

2. A standard R technique of factor analysis was chosen as a tool to analyze patterns of test scores. The DERS Fact 20 (Principal

Components factoring) program was used to analyze the test score patterns for each group of children on the WPPSI, on the readiness tests and on the WPPSI and readiness test scores combined.

3. In order to assess the relationship between the WPPSI and the readiness test scores, a stepwise regression analysis was completed. The DERS MULR06 program was used to determine which WPPSI subtests best predicted scores on the screening tests of academic readiness.

4. Because standard techniques of factor analysis were impractical for use in forming subgroups of people, a different procedure was selected--the Q technique. The Q technique of factor analysis was used by Doehring and Hoshko (1977) to define homogeneous subgroups of problem readers. The authors of the study claimed, "The Q technique groups together children who show similar patterns of test scores" (Doerhing and Hoshko, 1977, p. 232). In the Q method of factor analysis, people scores rather than test scores are intercorrelated and a loading matrix of people to factor scores is determined. The DERS Fact 20 (Principal Components) factoring program was adapted to a Q method and was used in the study to determine homogeneous subgroups of children in each sample group. A description of the procedures used to adapt the Fact 20 program to Q methodology is made in the next chapter.

Limitations of the Study

In order to make the interpretation of the results more meaningful, the scope of the present study was delimited by excluding from the sample children with problems associated with known sensory impairment, cultural differences and diagnosed mental retardation. It was recognized that children with these primary deficits may also have learning disability. However, it was not within the scope of the research to study these factors.

In addition, there were several limitations of the study.

1. A disproportionate number of boys were referred for assessment and selected for the nonachieving group. Although teacher bias was implicated, the large number of boys in the two groups sampled creates problems in generalizing results of this study to other dysfunctional groups containing a larger number of girls.

2. Because of the heterogeneity of the children's presenting problems in the nonachieving group, problems of generalizability of the findings of the study to specific groups of learning disabled children are anticipated.

3. Although a prpblem of most studies that employ inferential methodology, the relatively small sample size employed in the study presents problems of generalizing and comparing findings to larger populations of regular achieving and educationally at risk children.

4. The rural residence of the children in the two groups in the study presents problems of generalizing the findings to children residing in urban centres.

Definitions

For the purposes of the present study, the following operational definitions were made:

1. Nonachieving Child. The nonachieving child had difficulty

learning despite adequate intelligence and was considered to be educationally at risk. The child presented the characteristics of learning disability as described in the literature. For the present study, the nonachieving child was considered to be the type of child who would likely have a learning disability diagnosed in the primary grades.

2. Achieving Child. The achieving child was one who had few significant behavioral, perceptual or intellectual problems to inhibit his learning. The achieving child was one judged by his parents and teachers to be developing normally while presenting no learning problems.

3. Hyperkinesis. A syndrome of hyperkinetic behavior was considered to be characterized by the following variables: (a) a score of 19 or above on the Davids Hyperkinesis Scale; (b) teacher reports of lack of motor control, impulsivity, noncompliance and poor listening skills.

4. Residence. Children residing within a ten mile radius of Grande Prairie were considered to be urban residents while those residing outside of this area were considered to be rural residents.

CHAPTER IV

RESULTS AND INTERPRETATION

The results of the data analysis will be presented in three sections. Descriptive statistics will be reported and discussed in the first section. In section two, the results of a factor analysis and a stepwise regression analysis of the WPPSI and the screening test scores will be presented. Finally, the results of a Q factor analysis will be described.

Descriptive Statistics

A program from the Statistical Package for the Social Sciences (SPSS) was used initially to analyze the data. The Descriptive Statistics and T tests program was selected in order to compare the sample groups on each of the number of variables included for study in the present investigation. For each of 39 variables included for investigation (see page 55), descriptive statistics were computed (i.e., mean, range, standard deviation) and two statistical tests of significance were performed.

The results for the descriptive analysis for eight of the variables under study are presented in Table 2. Although chronological age was not a variable included for analysis, it was included in Table 2 because the nonachieving group was found to be a statistically significant older group. The mean age of the nonachieving children was two and one half months higher than the mean age of the achieving children; this was a statistically significant difference. The remaining seven variables were included in Table 2 because they were total or composite test scores. The verbal, performance and full scale IQ variables were derived from the total scores of the WPPSI subtests. The ABC, Dallas, Davids and Brenner total score represented the sum of the raw scores of each subsection in each of the screening tests. Descriptive statistics for the subtests are presented in Appendix H since it was not considered necessary to describe that amount of detail at this point.

The results of the descriptive analysis suggests a pattern of functioning for the nonachieving group that is different from the pattern for the achieving children. Even though the mean age of the achieving children is significantly lower, with one exception the mean scores for the achieving group are higher. Furthermore, there is more variability for the nonachieving group as demonstrated by greater ranges and standard deviations. For the one exception, on the scores of the Davids Hyperkinesis Scale, the pattern is reversed. The nonachieving group has a higher mean score and smaller range and standard deviation scores. This finding is due to the nature of the Davids scale; the higher mean score illustrates poorer functioning, i.e., greater frequency of hyperkinetic behavior.

As indicated earlier, as a group, the nonachieving children are older than the achieving group of children. However, the results of the descriptive analysis indicate that the nonachievers have areas of functioning more seriously depressed or indicative of more serious

Table 2

Characteristics of Age, Intelligence and Screening Test Variables for Two Groups of Subjects

Variable	Achieving			Non-Achieving		
	Range	Mean	Standard Deviation	Range	Mean	Standard Deviation
Chronological Age (Months)	60-76	68.00	4.15	60-78	70.40	5.35
Verbal IQ	90-131	105.32	10.10	64-121	89.00	14.28
Performance IQ	86-122	104.22	9.09	67-123	96.07	12.73
Full Scale IQ	90-128	105.30	8.46	69-116	91.90	11.67
ABC Total	72-114	99.90	8.74	38-114	83.67	20.24
Dallas Total	189-255	224.10	16.85	110-261	185.97	37.34
David's Total	8-31	16.90	5.56	11-32	20.52	4.63
Brenner Total	39-74	61.55	8.79	12-74	53.97	16.60

impairment compared to the achieving children. The differences between the functioning of the achieving and nonachieving children, as illustrated by the test variables in Table 2, are all significantly different. A comparison of the mean difference between the groups indicates that the nonachieving children are significantly weaker in intellectual skills as measured by the WPPSI and in readiness skills as measured by the screening tests. In addition, the differences between the verbal and performance IQ scores within the nonachieving group indicates that these children have a relative weakness in verbal reasoning and language skills.

Two statistical tests of significance were performed: an F test of sample group variance and a t test of sample group means. These tests were computed in order to determine whether differences existed between the sample groups on each of the 39 variables under study. The statistical analysis of the score characteristics (range, standard deviation, mean) of each variable provided an additional method of comparing the achieving and nonachieving sample groups. The F test was used to compare the sample group variances and the t test was used to compare sample group means.

The results of the F and t tests of significance of the scores of the eight variables described previously are presented in Table 3. A 5% confidence level represents the level of significance chosen for each statistical test. The reader will note that two methods were used to estimate the t statistic. When a homogeneity of variance

Table 3

Results of t Tests on Means of Age, Intelligence and Screening Test Variables

Variable	F Value	2 Tail Probability	Pooled Variance T Value	Pooled Variance 2 Tail Probability	Separate Variance T Value	Separate Variance 2 Tail Probability
Chronological Age	1.66	.117	2.24	.04*		
Verbal IQ	2.00	.03*			5.90	.00*
Performance IQ	1.96	.04*			3.29	.00*
Full Scale IQ	1.90	.05*			5.88	.00*
ABC Total	5.36	.00*			4.65	.00*
Dallas Total	4.91	.00*			5.88	.00*
Davids Total	1.44	.25	3.16	.002*		
Brenner Total	3.57	.00*			2.55	.01*

* denotes statistical significance at the .05 level of confidence

assumption was tenable, that is, when the sample group variances for a variable was similar, a pooled variance estimate of the probability of t was used. An example is the chronological age variable. A separate variance or nonparametric estimate of t was used when a homogeneity of variance was not possible, as when the sample group variances for a variable were dissimilar. An example is the verbal IQ variable.

The results of the tests of significance in Table 3 indicate that nonsignificant differences were found between the sample group variances for the two variables of chronological age and measures on the Davids. This finding indicates that the range of scores of these variables was similar for both sample groups. However, significant differences were found for the sample group variances for the remaining six variables (see Table 3) which suggests that the range of scores of these variables differed for the sample groups.

The results of the t tests indicate that significant differences were found between the two sample groups on the means of all variables listed in Table 3. The results of the tests of significance of the remaining variables are included in Appendix 1. It was not considered necessary to describe the amount of detail contained in Appendix 1 in the text.

In summary, the results of the statistical analyses utilizing descriptive statistics are reported in this section. The results indicate that the achieving children scored at a higher level on both the intelligence and screening tests for readiness for school learning than the nonachieving children. The finding of significant differences between the sample group means on the test variables in Table 3 is evidence that the two sample groups differed in overall functioning. Moreover, the heterogeneity of the nonachieving children is illustrated by the greater variability of their test scores and by the finding of significant differences on most of the sample group variances. As well, the differences in results on Davids Scale confirms that the nonachieving children, as a group, also present with the characteristics of the syndrome of hyperkinesis as described in the literature on learning disability.

Factor and Regression Analyses

The DERS Principal Components Factoring (Fact 20) and Stepwise Regression (MULR06) programs were used to complete the factor and multiple regression analyses of the data respectively. The procedures were used to discover whether meaningful relationships existed between the WPPSI and screening test scores for the children sampled.

The principal components method of factor analysis with varimax rotation was selected for two reasons. Since the method had been used by Hollenback and Kaufman (1973) in an earlier study to factor analyze the scores for the WPPSI standardization sample, it was used in the present study to discover whether the results could be replicated. In addition, the principal components method appeared to be a rigorous procedure for determining meaningful clusters of variables. By extracting a maximum amount of variance as consecutive factors were determined, the procedure maximized the difference between the factors or test score clusters. As a standard factor analytic technique, the principal components method provided a way to determine whether relationships would be found between the sample groups on the test variables under investigation. The reader will note that eight composite variables were selected and the results discussed in the section on the descriptive analyses. Because it is possible that the subtests measure a variety of different skills, the nature of which may not be observed when using composite scores, the factor analyses were completed using all of the subtest scores.

In order to select and to interpret meaningful factor solutions for each of the analyses performed, the following criteria were employed:

1. A factor loading of .40 or above was considered to be significant. This level was chosen because it was used by Hollenback and Kaufman (1973) in an earlier factor analysis for the WPPSI standardization sample (loadings of .40 and above are underlined in the following tables).

2. Cattell's scree test (Cattell, 1966) was used to select the most statistically meaningful factor solution. By plotting the eigenvalues for each factor, the beginning point of the straight scree line provided a graphic indicator of the number of the last factor contributing significantly to common factor variance.

3. Thurstone's principles of simple structure were used to guide the choice of factors. In this empirical method, the factor analyst

finds the factor solution or loading matrix characterized by "pure" factors, i.e., factors with variables loading on one factor and not another. The choice of Thurstone's criteria was made because of extensive use of the principles is found in factor analytic research as reported by authors such as Kerlinger (1964).

4. The variables loading each factor were analyzed to determine whether a factor made sense psychologically.

The results of three factor analyses are reported.

1. A factor analysis of the WPPSI subtest scores for each of the achieving and nonachieving groups.

2. A factor analysis of the readiness screening test scores for each of the achieving and nonachieving groups.

3. A factor analysis of the WPPSI and readiness screening test scores combined for each of the achieving and nonachieving groups.

The unrotated WPPSI factor matrices are presented in Table 4 for the achieving and nonachieving groups respectively. The factors are similar for each group, that is, for each group a general factor and one other interpretable factor were found.

Table 4

Unrotated Principal Components Axes of WPPSI Subtests for Achieving and Non-Achieving Children

	Achieving			Non-Achieving		
Variable	Factor			Factor		
	I	II	III	I	II	III
Verbal Subtests						
Information	67	-39	-31	68	-39	29
Vocabulary	70	-47	12	75	-50	-17
Arithmetic	81	-09	-15	70	07	20
Similarities	48	-45	56	75	-42	-25
Comprehension	63	-40	33	70	-59	12
Sentences	63	-38	-39	58	-39	-15
Performance Subtests						
Animal House	68	37	30	56	54	-12
Picture Completion	40	50	-20	54	51	52
Mazes	42	67	32	64	60	11
Geometric Design	75	44	-08	50	52	-41
Block Design	57	50	-38	46	70	-20

For each group, the 11 WPPSI subtests load on a general factor (labelled factor I). The significant loadings, which range from .40 to .81 for the achieving children and from .46 to .75 for the nonachieving children, demonstrate that factor I represents a general intelligence factor. For each group, the six verbal subtests tend to load factor I more strongly than do the performance subtests. The higher verbal subtest loadings for both groups indicate that the verbal subtests constitute the best measures of general intelligence for the children in the achieving and nonachieving groups. Wallbrown, Blaha and Wherry (1973) reported the same finding for children in the original WPPSI standardization sample.

Although the loadings on factor I (reported in Table 4) are significant, the order in which the subtests load the factor (from highest to lowest) differs for the sample groups. For example, a combination of three verbal and two performance subtests have the highest loadings for the achieving children, i.e., Arithmetic, Geometric Design, Vocabulary, Animal House and Information. On the other hand, five verbal subtests load highest on factor I for the nonachieving children, i.e., Vocabulary, Similarities, Arithmetic, Comprehension and Information. For both groups, the rank order of subtests loading the general factor differs from the rank order of subtests reported by Wallbrown, Blaha and Wherry (1973) as the best estimates of general intelligence, i.e., these authors reported the Information, Arithmetic, Comprehension and Vocabulary subtests.

The WPPSI verbal subtests loading factor I for the nonachieving children do not load in the same rank order although the same verbal subtests reported by Wallbrown and his coresearchers as the best measures of general intelligence was found. In contrast, the WPPSI subtests of the achieving children load factor I in a verbal-performance pattern as the WISC-R subtests loading a general factor at the 6 year 6 month age level (Kaufman, 1975). In this study, Kaufman reports that three verbal and two performance WISC-R subtests represent the best measures of general intelligence at the 6 year 6 month age level, i.e., Information, Arithmetic, Vocabulary, Picture Arrangement and Block Design.

The results in Table 4 also show that for both groups the performance subtests load a second factor (labelled factor II). In an earlier study of the WPPSI standardization sample, Hollenback and Kaufman (1973) illustrate, but do not interpret, significant performance subtest loadings on a second, unrotated factor. This author found it difficult to interpret factor II for both sample groups in terms of psychological or statistical meaning.

Factor III in Table 4 was considered to be uninterpretable because, for each group, only one subtest loaded the factor, i.e., Similarities for achieving and Picture Completion for nonachieving children. Since factor III was not significantly loaded by more than one subtest, the factor was not considered to be statistically or psychologically meaningful.

The results of the factor analysis of the WPPSI subtests computed using a varimax rotation are presented in Table 5. A consideration of both the factor selection criteria and the scree test results indicate that a two factor solution is best for both groups of subjects. In contrast to the first factor analysis with unrotated factors, for each of the sample groups on the rotated factors, the WPPSI subtests load on either a verbal or spatial factor but not on both. The only exception is the Arithmetic subtest which loads similarly on each of the factors.

The Arithmetic subtest uses tangible materials (blocks, cards with pictures) and is the only verbal subtest that requires the child to count or point in addition to verbalizing. It is possible that the verbal and nonverbal requirements of the Arithmetic subtest explain why the subtest loads two factors.

The results in Table 5 show that two factors conform to the verbal and performance subtests of the WPPSI. The present finding provides support for a similar finding for a two factor WPPSI structure reported by Hollenback and Kaufman (1973), Mukherjee (1975) and Wallbrown, Blaha and Wherry (1973). No evidence of a third factor similar to the freedom from distractibility factor as reported by Kaufman (1975) for the WISC-R (i.e., resulting from a combination of the Digit Span, Coding and Arithmetic subtests) is available in the present data.

Table 5

Varimax Rotated Factor Patterns of Principal Components Factoring of WPPSI Subtests for Two Groups of Subjects

	Achieving		Non-Achieving	
	Factor		Factor	
Variable	I	II	I	II
Verbal Tests				
Information	73	11	77	11
Vocabulary	84	09	90	08
Arithmetic	69	45	50	49
Similarities	65	04	85	13
Comprehension	74	09	92	-03
Sentences	73	11	70	06
Performance Tests				
Animal House	29	72	10	77
Picture Completion	-01	64	10	74
Mazes	-11	79	13	87
Geometric Design	29	82	08	72
Block Design	12	75	-07	84

A comparison of the magnitude of factor loadings illustrated by the factors in Table 5 indicates that the loadings on the WPPSI subtests for both factors tend to be higher for the nonachieving compared to the achieving children. The finding of higher loadings for the nonachieving children does not indicate quantifiable skill differences between the two groups. However, the result may indicate that specific subtests may possibly be better predictors of intellectual skills of nonachieving children than are other subtests.

The relatively high loadings of the Comprehension and Vocabulary subtests indicate that these subtests represent the best two measures of verbal ability for both the achieving and nonachieving groups of children. However, the order of loadings on factor I indicates that for both groups different verbal subtests represent the best measures of verbal ability, i.e., Similarities, Information, and Sentences for the nonachieving group and Information, Sentences and Arithmetic for the achieving group. Although the performance subtests have moderate to high loadings (i.e., in the .70 to .80 range) on factor II for both groups, the only distinct difference in the order of subtest loadings is the Geometric Design subtest (i.e., first in rank order for achieving and fifth in rank order for nonachieving children). Although the order of the other subtests in factor II for both groups is similar, high loadings were found for the Picture Completion, Mazes and Block Design subtests for the nonachieving children. Tests of perceptual organization ability appear to best predict nonverbal intellectual skills in nonachieving children.

The results of the factor analysis of the screening test scores for academic readiness are reported in Table 6. Following an analysis of both the scree test results and the tests loading the factors, a three factor solution was selected for each sample group. At this point the reader should note that a change was made in the method of analyzing one test variable. Because the fourth section of the ABC test (variable number 18 on page 56) was composed of four different tasks (counting, folding a triangle, memory for digits, copying a square), a decision was made to factor analyze the score for each task separately because each task was thought to measure a different skill. The counting task was dropped from further analysis because little variance was contributed by this variable.

The results reported in Table 6 demonstrate that the tests loading factor I for both sample groups seem primarily to measure language skills, e.g., Concepts, Psychological, Auditory, Language and Sequential Digits. The exceptions to this finding were the Number Recognition and Copying a Square tests of the nonachieving children. It may be that the nonachieving children used a verbal mediation strategy to complete these tasks. Factor II for the achieving groups is factorially complex; the factor is loaded by tests that seem to measure visual motor, language and reasoning skills, i.e., Copying a Square, Language and Folding a Triangle. Factor III for the achieving children is loaded by tests that seem to require visual motor integration skills, i.e., Draw A Man,

Table 6

Varimax Rotated Factor Patterns of Principal Components
Factoring of Screening Tests for Two Groups of Subjects

		Achieving			Non-Achieving		
		Factor			Factor		
	Variable	I	II	III	I	II	III
ABC	Draw A Man	01	-04	75	13	84	32
	Facts	39	19	49	38	46	08
	Concepts	68	-09	-008	82	24	-02
Dallas	Psychological	75	03	16	86	21	31
	Auditory	72	48	13	82	08	25
	Visual	29	65	38	27	61	46
	Language	44	61	02	83	01	16
	Motor	-17	56	04	14	61	47
BGT	Number Producing	-07	-44	31	23	09	81
	Number Recognition	14	46	29	53	36	55
	Ten Dot Gestalt	-09	03	72	09	20	84
	Sentence Gestalt	30	49	30	21	54	67
	Draw A Man	11	-02	78	08	75	44
ABC	Fold Triangle	-01	55	-16	02	27	47
	Sequential Digits	75	09	-11	65	27	03
	Copy Square	-36	44	-28	48	67	00

Ten Dot Gestalt. In contrast, the tests loading factor II for the nonachieving group clearly measure visual motor integration skills while tests of nonverbal reasoning load factor III. Children who lack the skills measured by the tests loading factor III, seem to have difficulty planning and executing a motor task.

For each sample group the results of the factor analyses of the WPPSI and the academic readiness screening test scores combined demonstrate a different factor structure. A five and a four factor solution were selected for the achieving and the nonachieving groups respectively (see Tables 7 and 8). In Table 7 for the achieving group, the first two factors (labelled factors I and II) are loaded by the WPPSI verbal and performance subtests respectively. Only two other tests load factor I significantly (i.e., Auditory, Language) while the Arithmetic subtest loads factor II along with the performance subtests. The loading of the WPPSI subtests on two distinct factors is the same finding as reported following the separate factor analysis of the WPPSI subtest scores for the achieving children (see Table 5).

Table 7

Varimax Rotated Factor Patterns of Principal Components Factoring of Combined WPPSI and Screening Tests for Achieving Subjects

		Factor				
	Variable	I	II	III	IV	V
	Information	70	16	14	09	-06
	Vocabulary	80	08	03	-04	23
	Arithmetic	71	44	-19	09	-04
	Similarities	63	01	-01	-22	-08
	Comprehension	64	09	17	09	28
	Sentences	73	06	00	30	22
WPPSI	Animal House	31	72	12	08	-28
	Picture Completion	02	58	17	24	-04
	Mazes	-10	78	04	-21	10
	Geometric Design	29	79	06	12	01
	Block Design	04	73	09	-05	29
	Draw A Man	02	13	03	74	-07
ABC	Facts	39	11	14	54	18
	Concepts	23	-32	-05	02	65
	Psychological	37	34	12	11	62
	Auditory	41	07	53	12	50
Dallas	Visual	20	14	70	23	20
	Language	61	-30	47	13	11
	Motor	07	16	51	-08	-19
	Number Producing	-49	37	-21	23	23
	Number Recognition	-01	09	56	28	04
BGT	Ten Dot Gestalt	-09	27	09	69	-09
	Sentence Gestalt	-01	-24	61	18	35
	Draw A Man	05	-22	02	77	17
	Fold Triangle	01	21	57	22	-09
ABC	Sequential Digits	10	28	27	-12	63
	Copy Square	06	-06	31	-25	-54

The results reported in Table 7 show that the screening test scores load three factors (labelled III, IV and V). Moreover, the screening tests loading factors III, IV and V are the same tests loading the factors reported for the factor analysis of the screening test scores for the achieving children, i.e., factors II, III and I respectively (see Table 6). The results indicate that for the achieving group the factor structure of the combined WPPSI and academic readiness screening test battery remains unchanged whether or not the test scores are factor analyzed separately or in combination.

The factor loading matrix in Table 8 for the nonachieving group contains four distinct factors (labelled factors I, II, III, IV). The tests loading on factor I measure visual motor skills (e.g., Draw A Man, Sentence Gestalt) and the tests loading factor II measure language skills (e.g., Sentences, Auditory). Factors III and IV in Table 8 are loaded by the WPPSI verbal and performance subtests respectively. With the exception of two other significant loadings on factors III and IV (i.e., Concepts, Folding a Triangle), the results in Table 8 indicate that the WPPSI factor structure remains unchanged for the nonachieving group whether or not the test scores are analyzed separately or in combination (see Table 5).

Table 8

Varimax Rotated Factor Patterns of Principal Components Factoring of Combined WPPSI and Screening Tests for Non-Achieving Subjects

	Variable	Factor			
		I	II	III	IV
	Information	06	14	12	77
	Vocabulary	09	31	04	83
	Arithmetic	-15	14	58	45
	Similarities	15	15	08	85
	Comprehension	-06	17	01	90
	Sentences	01	70	06	46
WPPSI	Animal House	17	13	74	05
	Picture Completion	02	12	76	06
	Mazes	45	08	74	11
	Geometric Design	25	07	65	07
	Block Design	35	-15	76	-02
	Draw A Man	83	03	18	27
ABC	Facts	51	26	-17	21
	Concepts	28	65	-17	48
	Psychological	36	81	14	25
	Auditory	21	82	20	06
Dallas	Visual	76	21	20	06
	Language	15	81	-03	22
	Motor	69	12	25	12
	Number Producing	61	25	12	-09
	Number Recognition	61	54	19	-01
BGT	Ten Dot Gestalt	67	12	21	-16
	Sentence Gestalt	78	21	28	01
	Draw A Man	76	03	33	17
	Fold Triangle	37	06	46	-13
ABC	Sequential Digits	19	59	26	16
	Copy A Square	57	44	-07	-07

The results reported in Table 8 for the nonachieving children indicate that tests of visual and auditory perceptual skills load factors I and II respectively. The tests of visual motor skills loading factor I are those previously reported in the results of the separate factor analysis of screening tests as loading two factors (see factors II and III in Table 6). With one exception (i.e., Copying a Square), the tests loading factor II measure auditory memory and language skills.

The results in Table 8 demonstrate that tests of perceptual and language skills emerge (i.e., factors I and II) before the WPPSI tests (i.e., factors III and IV) in the factor matrix for the nonachieving children. The pattern is reversed for the achieving children, i.e., the factors loaded by the WPPSI subtests emerge in the factor matrix before the factors loaded by the screening tests (see Table 7). The finding that tests of perceptual and language skills emerge first in the factor solution indicates that perceptual and language skills may be stronger predictors of achievement for the nonachieving children than intellectual skills. Moreover, nonverbal intellectual skills appear to be a stronger predictor of intelligence than verbal skills as shown by Factors III and IV in Table 8. On the other hand, the results in Table 7 indicate that the achieving children appear to be employing higher order reasoning and intellectual skills rather than perceptual skills in day-to-day functioning.

The results of a factor analysis of the screening test scores combined for the total sample indicate that five factors are interpretable. The factor analysis was performed in order to obtain the criterion variables for a stepwise regression analysis. The results are not discussed here but they are available from the present author. The DERS (Fact 23) Factor Estimates program was used to obtain a verbal and a nonverbal factor score for each test variable used in the factor analysis of the screening test scores combined for the total sample group. The factor and WPPSI subtest scores were correlated and a stepwise regression analysis was completed with the WPPSI subtests as the predictor and the factor scores as the criterion variables.

The DERS (MULR06) Stepwise Regression program was utilized in order to determine what WPPSI subtests could be identified as significant predictors of the screening test factor scores. The stepwise regression approach used in the present study started with the correlation matrix (i.e., between the WPPSI and the screening test factor scores) and entered into the regression the predictor variable (i.e., a WPPSI subtest) most highly correlated with the criterion (i.e., a factor score). By determining in successive stages which variables accounted for the most variance, the stepwise regression determined which WPPSI subtests best predicted the factor scores. By determining which of the WPPSI subtests best predicted the criterion variables (i.e., factor scores), an additional method of analyzing the relationships among the test variables was made possible.

Two stepwise regression analyses were performed: (a) between the WPPSI verbal subtests and the verbal factor scores; (b) between the WPPSI performance subtests and the nonverbal factor scores. The results of the regression analyses of the WPPSI verbal subtests and the verbal factor scores are shown in Table 9.

The results in Table 9 indicate that the first WPPSI subtest retained in the regression was variable 6 or the Sentences subtest. The Sentences subtest, which appears to measure immediate recall and attention, accounts for 58% of the variance of the verbal factor scores of the screening tests of academic readiness. The second WPPSI verbal subtest retained in the regression was the Similarities subtest. The Similarities subtest accounts for 62% of the variance of the verbal factor scores. The Similarities subtest appears to measure the ability to form verbal concepts. The results of the stepwise regression using the WPPSI performance subtests as the predictor and the factor scores as the criterion variables indicate that the Block Design subtest accounts for 22% of the variance of the nonverbal factor scores. The Block Design subtest appears to measure nonverbal reasoning ability and is the only WPPSI performance subtest retained in the regression.

In summary, the results of the factor and regression analyses are reported in this section. The results indicate that the factor structure of the WPPSI is basically the same for each sample group. Although the results demonstrate a different rank ordering of subtests in the respective factors, both sample groups had WPPSI subtests with significant loadings on a general and on two specific factors, i.e., verbal and nonverbal. The Arithmetic subtest is the exception, a finding reported in earlier factor analytic studies of the WPPSI.

Table 9

Results of Regression Analyses of WPPSI Subtests and Screening Test Factor Scores

	Regression Analysis Between		
Variable	Verbal Scores		Non-Verbal Scores
Step Number	1	2	1
Variable Entering	6	4	11
F Value	111.62	7.54	23.07
Probability Level	.00	.007	.00
Percent Variance	58.86	62.53	22.82

For the achieving group, the factor structure of both the WPPSI and the screening tests remains unchanged when the test scores are factored either together and separately. For the nonachieving children, the screening tests combine to form two factors when the WPPSI subtests and screening test scores are combined and factored. The finding for the nonachieving children that tests of perceptual rather than intellectual skills emerge first in the factor solutions of the combined test scores is significant. For the achieving children the pattern is reversed. The results indicate that the children in each sample group may use different skills in their day-to-day academic functioning, i.e., perceptual for the nonachieving group and intellectual for the achieving group.

The finding that three subtests (i.e., Sentences, Similarities and Block Design) best predict the factor scores for the sample group combined, indicates that a shortened WPPSI may predict functioning on the screening tests of academic readiness. Moreover, the finding indicates that specific intellectual abilities (i.e., memory, verbal and nonverbal reasoning) may best predict the performance of either achieving or nonachieving children on screening tests of academic readiness.

Q Factor Analysis

A Q technique of factor analysis was the final statistical method used to analyze the data. In order to complete the analysis, the DERS Principal Components Factoring (Fact 20) program was adapted to a Q method. In order to adapt the Fact 20 program to a Q method, the raw scores for each test variable used in the previous analyses were converted to Z scores (i.e., standardized) and the data matrix was transposed (i.e., test scores listed in rows and people in columns). By using the standardized scores, a common test metric was obtained and by transposing or inverting the data matrix, a matrix of person to person correlations was determined. By factor analyzing the correlation matrix, a loading matrix was illustrated that was characterized by factors loaded by the scores of people rather than by the scores of tests. As with the interpretation of any factor solution, the factors obtained by the Q method were assumed to represent clusters of variables (i.e., people) who shared a common characteristic (i.e., similarity of test score profile).

The Q factor analysis of the test scores for the sample groups combined yielded five factors or subgroups of children. Because the factor matrix (not shown) had a number of loadings (18 for nonachieving group) below the criterion (.40) selected to represent significant loadings, the criterion was dropped for the Q analysis and all loadings were considered meaningful. There was only one negative loading for the nonachieving group that was included in the analysis.

However, a number of negative loadings in the four factor solution (i.e., five for nonachieving group) and a poor six factor solution (i.e., factors loaded by scores also loading other factors), indicated that the five factor solution was correct in terms of statistical interpretation and psychological meaning.

Once the number of subgroups was determined, an empirical analysis of the profiles of the WPPSI and the screening test scores for each of the subgroups was made. The psychometric profile of each subgroup was determined by averaging the raw test scores for each child in the subgroup. The subgroup psychometric profile was then described; as well the WPPSI test scores of one child were presented to illustrate the subgroup profile.

The reader should note that because raw scores were used, comparisons of test scores on different screening tests were not made (i.e., Dallas Language score with ABC Concepts score). However, the relative standing of the respective subgroups on sections of the screening tests were compared (e.g., subgroup 1 were higher on Dallas Language than were subgroup 5). Because the WPPSI subtest scores were scaled, it was possible to make comparison between and within subgroups using the intellectual variables.

Subgroup 1. The psychometric profile of the WPPSI subtests for subgroup 1 (see Figure 2) for the nonachieving children is characterized by average scores on the performance subtests and borderline scores on the verbal subtests of the WPPSI. The relatively lower verbal subtest scores and a mean verbal IQ of 88 indicates that the children in this subgroup are dysfunctional in language skills. Although the children score at an average level on the performance subtests (e.g., performance IQ of 104), a discrepantly low Block Design score for the subgroup indicated possible nonverbal reasoning difficulties as well as the verbal dysfunction.

The scores on the screening tests of school readiness for subgroup I are the highest among the nonachieving children (see Figure 3). The children in this subgroup are rated lowest of all the nonachieving children on the Davids Hyperkinesis Scale, i.e., mean score of 16.

A typical example of a WPPSI profile for a subgroup I child is presented here. The scores in parentheses represent the mean scores for the eight children in subgroup I.

Child #20

Verbal IQ	85 (89.2)
Performance IQ	104 (104.2)
Full Scale IQ	93 (96.3)

Verbal Subtests		Performance Subtests	
Information	6 (8.5)	Animal House	12 (11.1)
Vocabulary	8 (8.5)	Picture Completion	11 (11.0)
Arithmetic	9 (8.5)	Mazes	11 (10.9)
Similarities	7 (8.8)	Geometric Design	10 (10.5)
Comprehension	8 (8.1)	Block Design	9 (9.6)
Sentences	10 (8.0)		

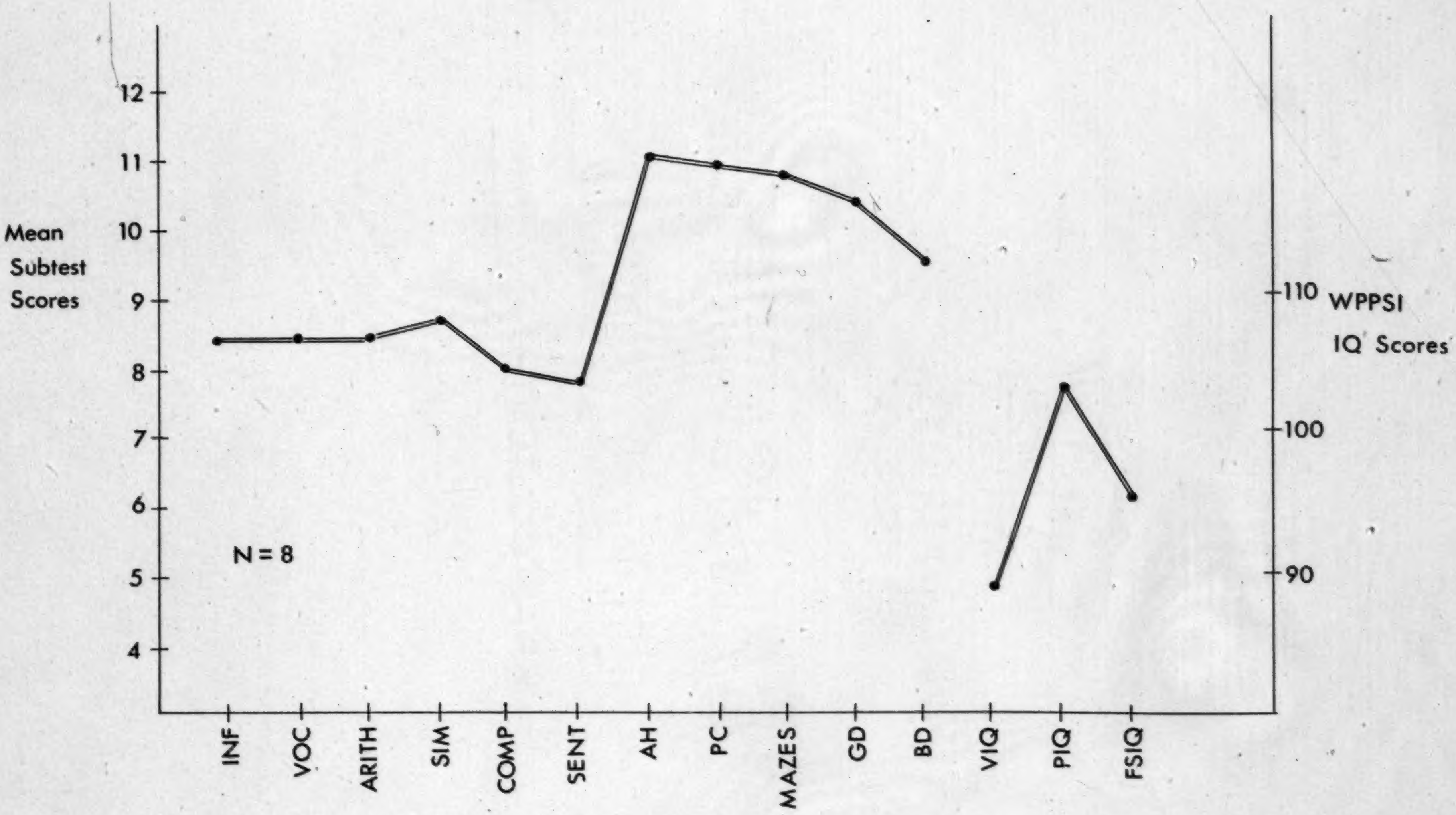

Figure 2. Mean WPPSI subtest and IQ scores for nonachieving children in subgroup 1.

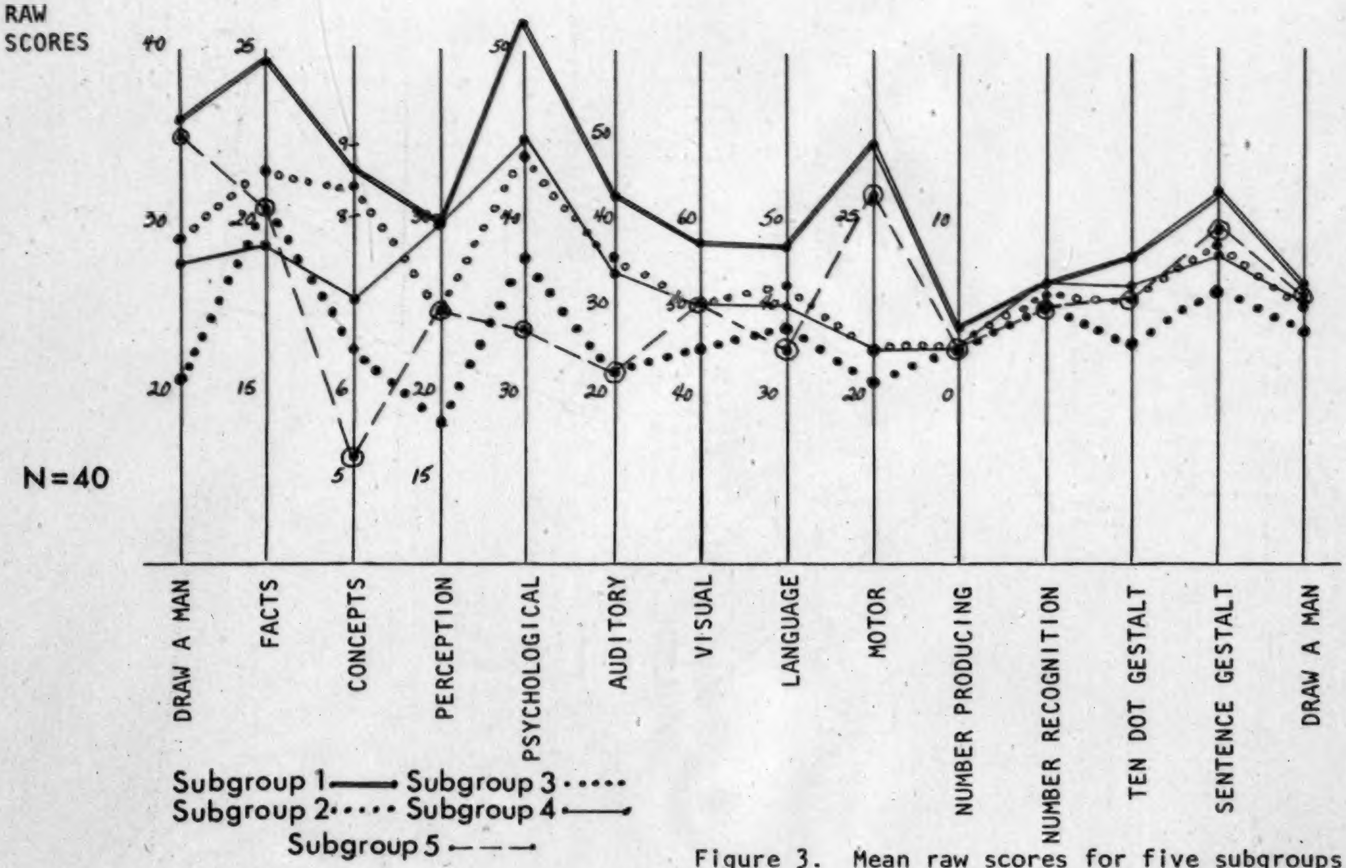

Figure 3. Mean raw scores for five subgroups of nonachieving children on subsections of the ABC, Dallas and Anton Brenner.

The child's pattern of WPPSI subtest scores resembles the pattern demonstrated by his subgroup as reported in Figure 2. Like the children in the subgroup the child has average nonverbal scores, but his weaker verbal scores are indicative of language dysfunction. The child is reported by his kindergarten teacher as being shy and nervous and requiring encouragement to participate in gymnasium activities. During the test session the child had difficulty defining words (i.e., Dallas Language) and he required prompting and encouragement to complete the test activities. The child's score on the Davids is 13 which is indicative of hypoactive behavior.

The psychometric score profile reported in Figures 2 and 3 and the WPPSI scores of the individual child indicate that subgroup I children have weak language and analytical reasoning skills. However, the children are able to successfully complete screening tests of academic readiness skills. The low rating on the Davids Hyperkinesis Scale indicates that subgroup I children are hypoactive. Although these chldren appear to have language problems, their withdrawn, unobtrusive behavior may have been the variable that caused them to be singled out and referred for assessment by their teachers.

Subgroup 2. The WPPSI verbal subtest scores of the children in subgroup 2 are the highest for the nonachieving children (see Figure 4). However, the children in subgroup 2 are among the lowest scorers on the WPPSI performance subtests, particularly on the subtests that require fine motor skills (see Figure 4, e.g., Mazes, Geometric Design and Block Design). Because the Arithmetic subtest score is discrepantly low, the children may be weak in quantitative reasoning skills. The below average WPPSI performance subtest scores for subgroup 2 is indicative of spatial dysfunction. As reported by Whyte (1978), children manifesting these difficulties may have academic learning problems in writing and arithmetic.

The children in subgroup 2 scored lowest of the nonachieving children on screening tests that require motor skills (see Figure 3, e.g., ABC Draw A Man, Dallas Motor, Ten Dot Gestalt). The low scores on screening tests of both verbal and nonverbal readiness skills indicate that the children have a pervasive spatial deficit that is affecting all areas of academic progress. The WPPSI score profile of one subgroup 2 child is now presented.

Child #38

Verbal IQ	90 (100.8)
Performance IQ	77 (90.6)
Full Scale IQ	82 (95.6)

Verbal Subtests		Performance Subtests	
Information	8 (10.6)	Animal House	9 (8.8)
Vocabulary	8 (9.6)	Picture Completion	7 (10.2)
Arithmetic	7 (9.0)	Mazes	6 (8.2)
Similarities	10 (10.0)	Geometric Design	5 (7.4)
Comprehension	9 (11.6)	Block Design	6 (7.4)
Sentences	7 (7.6)		

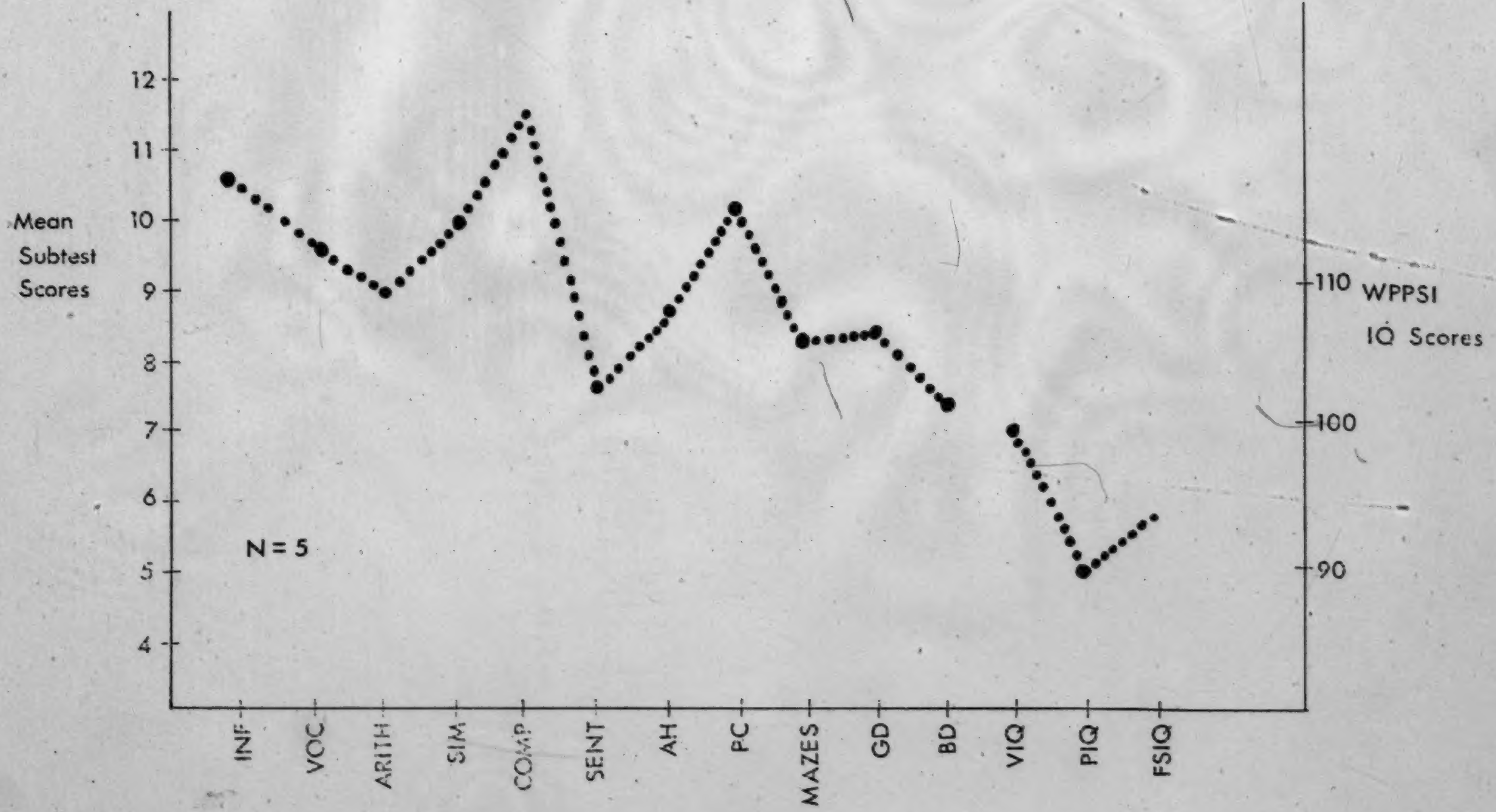

Figure 4. Mean WPPSI subtest and IQ scores for nonachieving children in subgroup 2

The child's WPPSI subtest scores are lower, in most cases, than the mean subtest scores for his subgroup, i.e., scores in parentheses. However, the lower performance subtest scores for the child fit the score profile for the subgroup which is indicative of spatial dysfunction. Moreoever, the child's Arithmetic and Sentences subtest scores are discrepantly low and indicate possible quantitative reasoning and memory problems.

The subgroup 2 child had difficulty completing screening tests of academic readiness that required him to use both gross (e.g., Dallas Motor) and fine motor skills (e.g., ABC Draw A Man, Ten Dot Gestalt). Like the other children in his subgroup, the child has relative success on tests requiring skills of visual perception (e.g., WPPSI Picture Completion and Dallas Visual). In addition, the child was rated on the Davids at the same level as his subgroup with a score of 21. The child was described by his teachers on referral as being distractible and awkward in completing physical education, coloring and drawing activities.

The psychometric profile for subgroup 2 indicates that these children present with a spatial deficit, poor quantitative reasoning and memory skills. In addition, clinical information indicates that the children in subgroup 2 are distractible.

Subgroup 3. The profile of the WPPSI scores for subgroup 3 (see Figure 5) is the lowest of the nonachieving subgroups and is characterized by little subtest score scatter. The borderline level of the Arithmetic, Similarities, Animal House and Block Design subtest scores indicate that children in subgroup 3 may have weak verbal and nonverbal reasoning skills--in short, borderline intelligence.

Although the children in subgroup 3 scored lowest on the WPPSI among the nonachieving children, these children did not score lowest on screening tests of academic readiness (see Figure 2). The results in Figure 2 show that subgroup 3 children scored at a median level compared to other nonachieving children on each subsection of the tests of academic readiness. However, the children in subgroup 3 are rated highest among the children in both sample groups by their teachers on Davids Hyperkinesis Scale, i.e., a mean score of 24.

The WPPSI score profile of a subgroup 3 child is presented at this point.

Child #12

Verbal IQ	81 (84.3)
Performance IQ	80 (84.0)
Full Scale IQ	80 (83.0)

Verbal Subtests		Performance Subtests	
Information	6 (7.9)	Animal House	5 (6.9)
Vocabulary	8 (7.6)	Picture Completion	10 (7.6)
Arithmetic	5 (6.0)	Mazes	8 (8.0)
Similarities	7 (7.6)	Geometric Design	7 (8.3)
Comprehension	9 (8.3)	Block Design	5 (7.0)
Sentences	5 (7.5)		

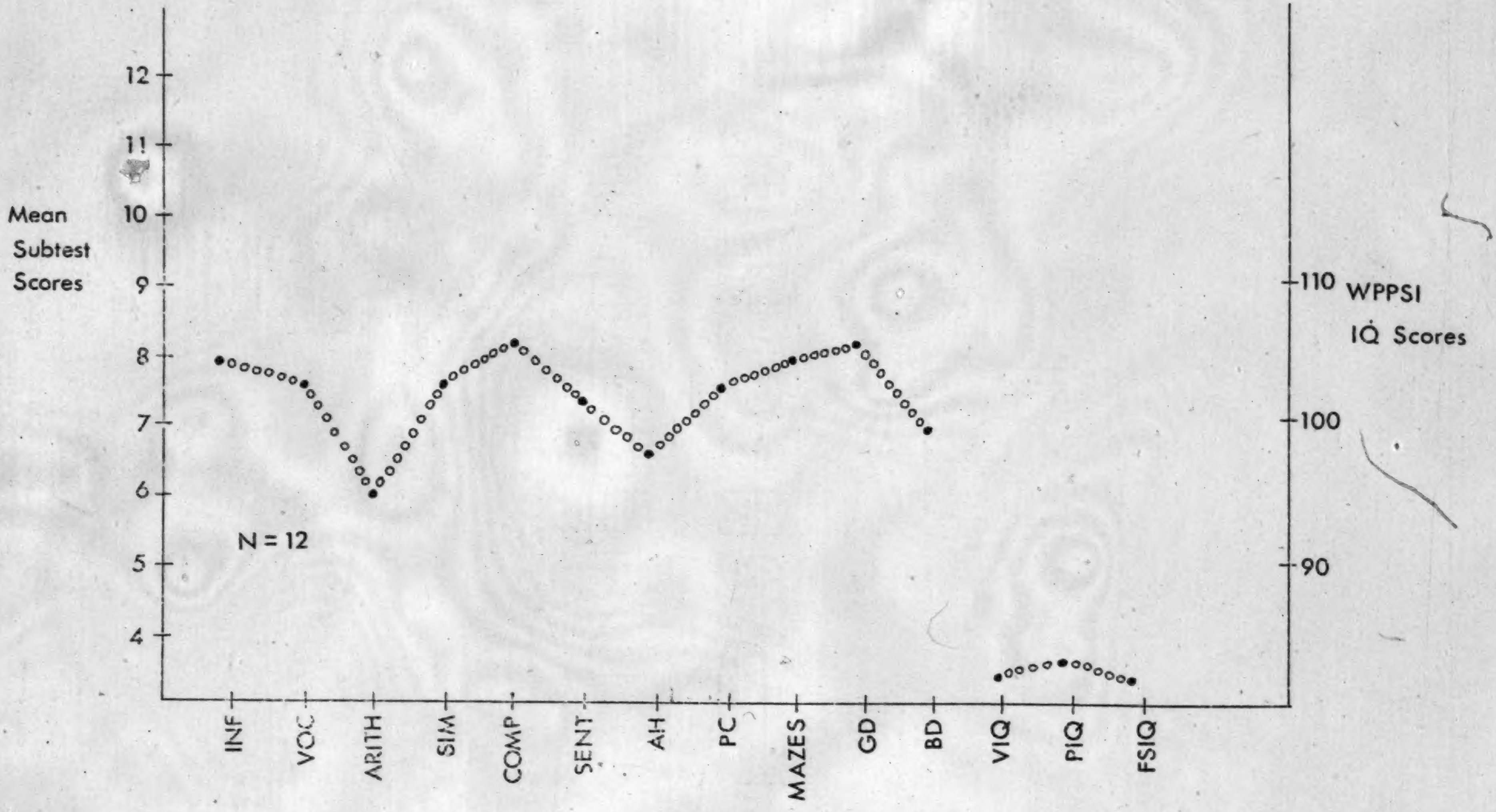

Figure 5. Mean WPPSI subtest and IQ scores for nonachieving children in subgroup 3.

Relatively little test score scatter is evident in the borderline WPPSI score profile of the subgroup 3 child. Discrepantly low scores on the Arithmetic, Sentences and Animal House subtests indicate that the child has possible memory problems. The child had difficulty successfully completing screening tests that required skills of auditory memory and sequencing (e.g., Dallas Auditory). When referred for testing the child was described by his teachers as being talkative, overactive and aggressive and having problems listening and attending in group instruction activities. The child was rated on the Davids with a score of 24 which is indicative of hyperkinetic behavior.

The psychometric profile for both the subgroup and the individual child demonstrates that subgroup 3 children present with borderline ability, memory problems and behaviors characteristic of the syndrome of hyperkinesis. The higher scores on the screening tests of academic readiness are inconsistent with the lower intellectual functioning of the subgroup 3 children. A possibility exists that behavior inhibited the functioning of the subgroup 3 children on intelligence tests.

Subgroup 4. The WPPSI score profile for subgroup 4 (see Figure 6) is characterized by below average scores on the Vocabulary and Sentences subtests. The borderline verbal and high average nonverbal subtest scores for the subgroup 4 children are indicative of language dysfunction. While subgroup 4 children appear to have weak auditory memory and vocabulary skills, the high average performance subtests indicate that the spatial skills of these children are intact. In addition, the children in subgroup 4 appear to have average verbal and nonverbal reasoning abilities as indicated by average to high average Similarities and Block Design subtest scores.

On the screening tests of academic readiness (see Figure 3), the children in subgroup 4 scored lowest among the nonachieving children in a test of general information, i.e., ABC Facts. The subgroup 4 children scored second highest among the nonachieving children on screening tests of visual motor skills, i.e., ABC Perception, Number Recognition, Ten Dot and Sentence Gestalt tests.

The WPPSI score profile of a subgroup 4 child demonstrated a pattern of low verbal skills (e.g., verbal IQ of 89) and high average nonverbal skills (e.g., performance IQ of 111). On referral the child was described as being overactive as well as having difficulty listening and participating in oral language activities. Like his subgroup, the child was rated with a score of 21 on the Davids Hyperkinesis Scale.

Child #34

Verbal IQ	89 (88.6)
Performance IQ	111 (106.6)
Full Scale IQ	99 (97.3)

Verbal Subtests		Performance Subtests	
Information	10 (8.6)	Animal House	11 (10.6)
Vocabulary	7 (6.8)	Picture Completion	12 (11.3)
Arithmetic	8 (9.0)	Mazes	12 (11.3)
Similarities	7 (8.1)	Geometric Design	11 (11.5)
Comprehension	9 (8.3)	Block Design	12 (10.3)
Sentences	7 (6.6)		

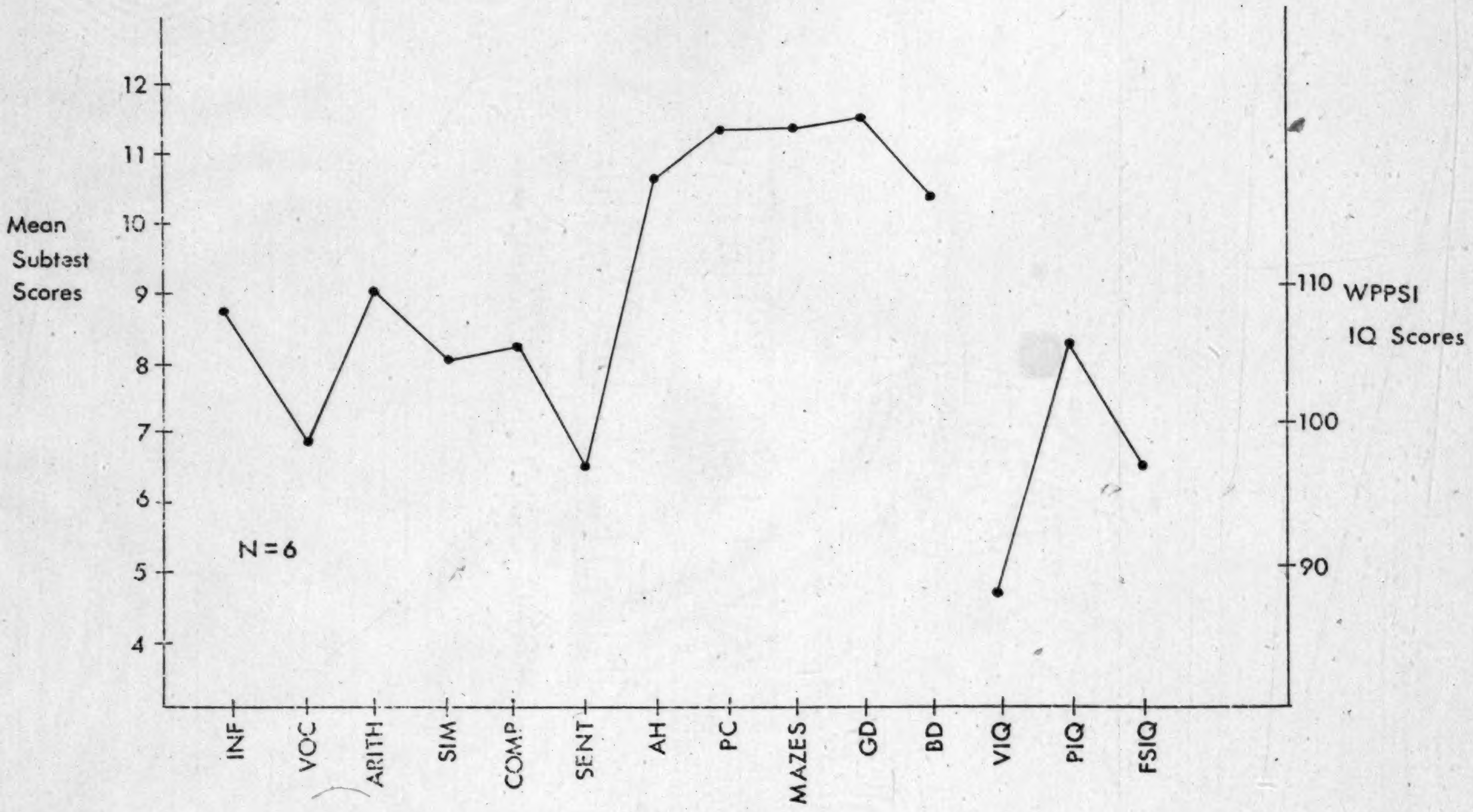

Figure 6. Mean WPPSI subtest and IQ scores for nonachieving children in subgroup 4.

The data presented for subgroup 4 indicate that these children have specific problems in language functioning that are related to weak vocabulary and auditory memory skills. In addition, the children appear to be difficult to maintain on task, particularly in group listening activities. The results on the Davids indicate that subgroup 4 children present with the characteristics of hyperkinetic behavior.

Subgroup 5. The psychometric profile for subgroup 5 children is similar to the profile for subgroup 4. On the WPPSI (see Figure 7), the children in subgroup 5 are lowest of the nonachieving children on the Vocabulary and Sentences subtests. A mean borderline verbal IQ of 88 indicates that the children in this subgroup are dysfunctional in language development. However, the subgroup 5 children have intact spatial skills as indicated by average performance subtest scores (see Figure 7).

The results in Figure 3 show that the subgroup 5 children scored lowest among the nonachieving children on screening tests of language readiness skills, i.e., ABC Concepts, Dallas Psychological, Auditory and Language. The WPPSI score profile of a subgroup 5 child is presented.

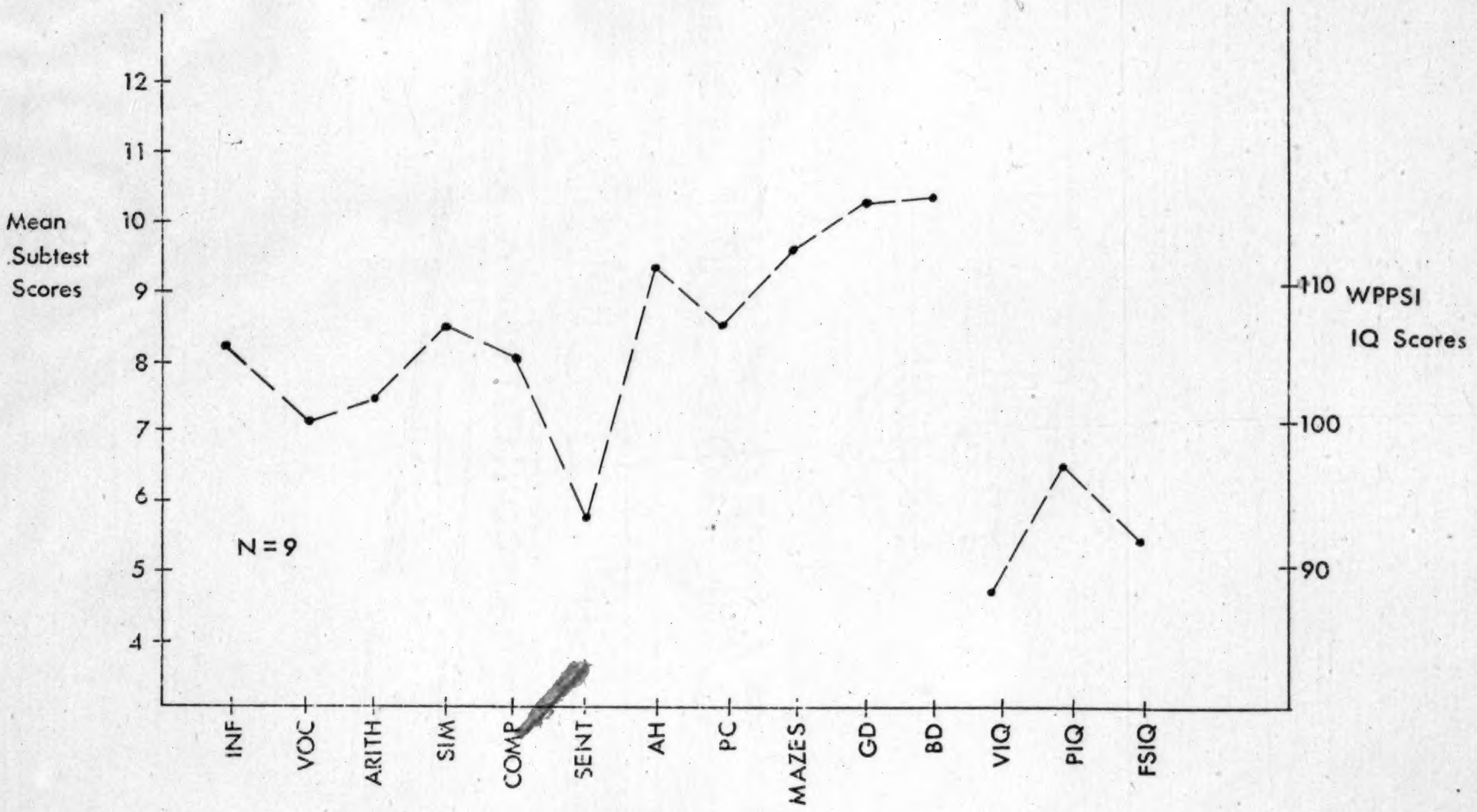

Figure 7. Mean WPPSI subtest and IQ scores for nonachieving children in subgroup 5.

Child #36

Verbal IQ	84 (88.5)
Performance IQ	107 (97.7)
Full Scale IQ	94 (92.4)

Verbal Subtests		Performance Subtests	
Information	8 (8.3)	Animal House	10 (9.3)
Vocabulary	6 (7.1)	Picture Completion	11 (8.4)
Arithmetic	8 (7.4)	Mazes	11 (9.5)
Similarities	6 (8.6)	Geometric Design	11 (10.4)
Comprehension	9 (8.2)	Block Design	12 (10.4)
Sentences	6 (5.7)		

The WPPSI score profile for the subgroup 5 child is characterized by below average scores on subtests that measure language skills, i.e., Vocabulary, Similarities and Sentences. The child's borderline verbal IQ of 84 is indicative of a langauge deficit which is confirmed by his below average performance on screening tests of language skills (e.g., Dallas Psychological, Auditory, Language).

The Davids score for the subgroup 5 child is 21 which is the same as the mean score for the subgroup. When referred for assessment the child, like the other subgroup 5 children, was described as having poor oral language skills. During assessment language was not spontaneous and it took prompting and encouragement to elicit language from this child. Although the child was described as being distractible, during testing he was compliant and completed tasks with minimal direction.

The psychometric profiles for subgroups 1, 4 and 5 shown in Figure 8 indicate that children in these subgroups have language deficits. The language deficit of subgroup 1 was uniform while the problems of subgroups 3 and 4 appeared to differ on the degree of severity. While the children in subgroup 3 presented with problems in speaking vocabulary as did the children in subgroup 5, the degree of the problem for the later group was more severe. The subgroups also differed with respect to behavior. As indicated on the Davids, the children in subgroup 1 were withdrawn and shy while subgroup 4 and 5 children were rated and described as presenting behaviors characteristic of hyperkinesis. In comparison, the psychometric profile for subgroups 2 and 3 were indicative of spatial and behavioral problems respectively.

The WPPSI score profiles for the five subgroups of achieving children are shown in Figure 9. No dysfunctional patterns of intellectual development are demonstrated for the achieving children. Although patterns of scores are evident in Figure 9, the patterns appear to represent a normal variation in skills since no below average subtest scores are demonstrated.

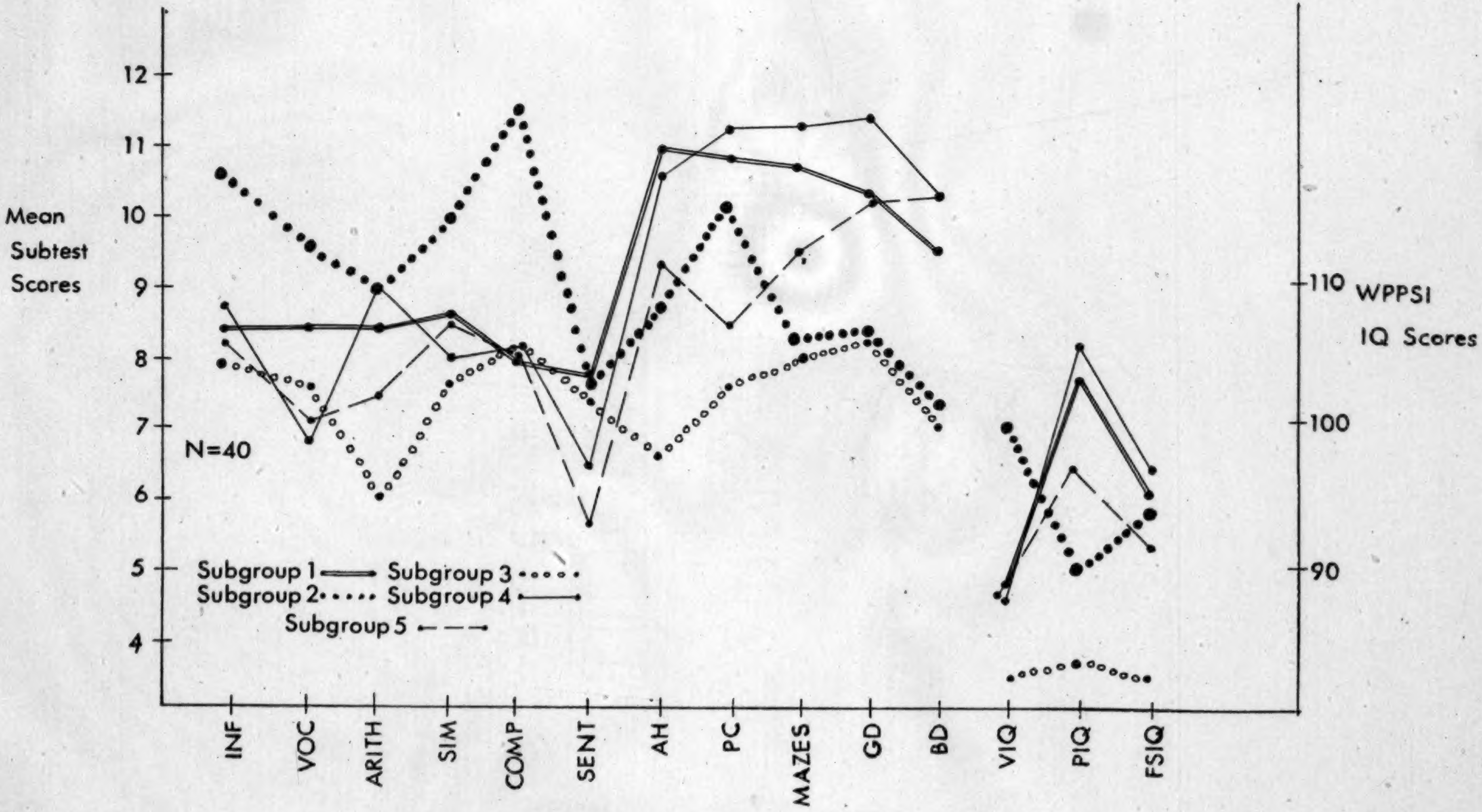

Figure 8. Mean WPPSI subtest and IQ scores for five subgroups of nonachieving children.

In Figure 9 the WPPSI profile for subgroup 1 (N = 16) is characteristic of a normally functioning average child. Although the Arithmetic and Sentence subtest scores are the lowest WPPSI scores for subgroup 1, all subtest scores are in the average range. The children in subgroup 1 scored highest among the achieving children on the Brenner Ten Dot Gestalt test while the other screening test scores were at a median level (see Figure 10). The mean score on the Davids for subgroup 1 is 15 which indicates that as a group the children did not present with the characteristics of hyperkinesis.

The profile for subgroup 2 (N = 9) in Figure 9 is indicative of a bright verbal child. The WPPSI verbal subtests for subgroup 2 children are the highest among the achieving children while the performance subtest scores are average. As shown in Figure 10, the children in subgroup 2 scored highest overall on screening tests of language skills, i.e., Concepts, Auditory, Language. The children in subgroup 2 were rated by their teachers with a mean score of 17 on the Davids which was below the score level indicative of hyperkinesis, i.e., 19.

The WPPSI profile for the subgroup 3 children (N = 4) in Figure 9 shows a possible deficit pattern in memory and sequencing skills, i.e., low average scores on the Arithmetic, Sentences and Animal House subtests. The possibility exists that these children are distractible; the mean score on the Davids is 22 which is the highest score for the achieving children. However, as compared to the other subgroups of

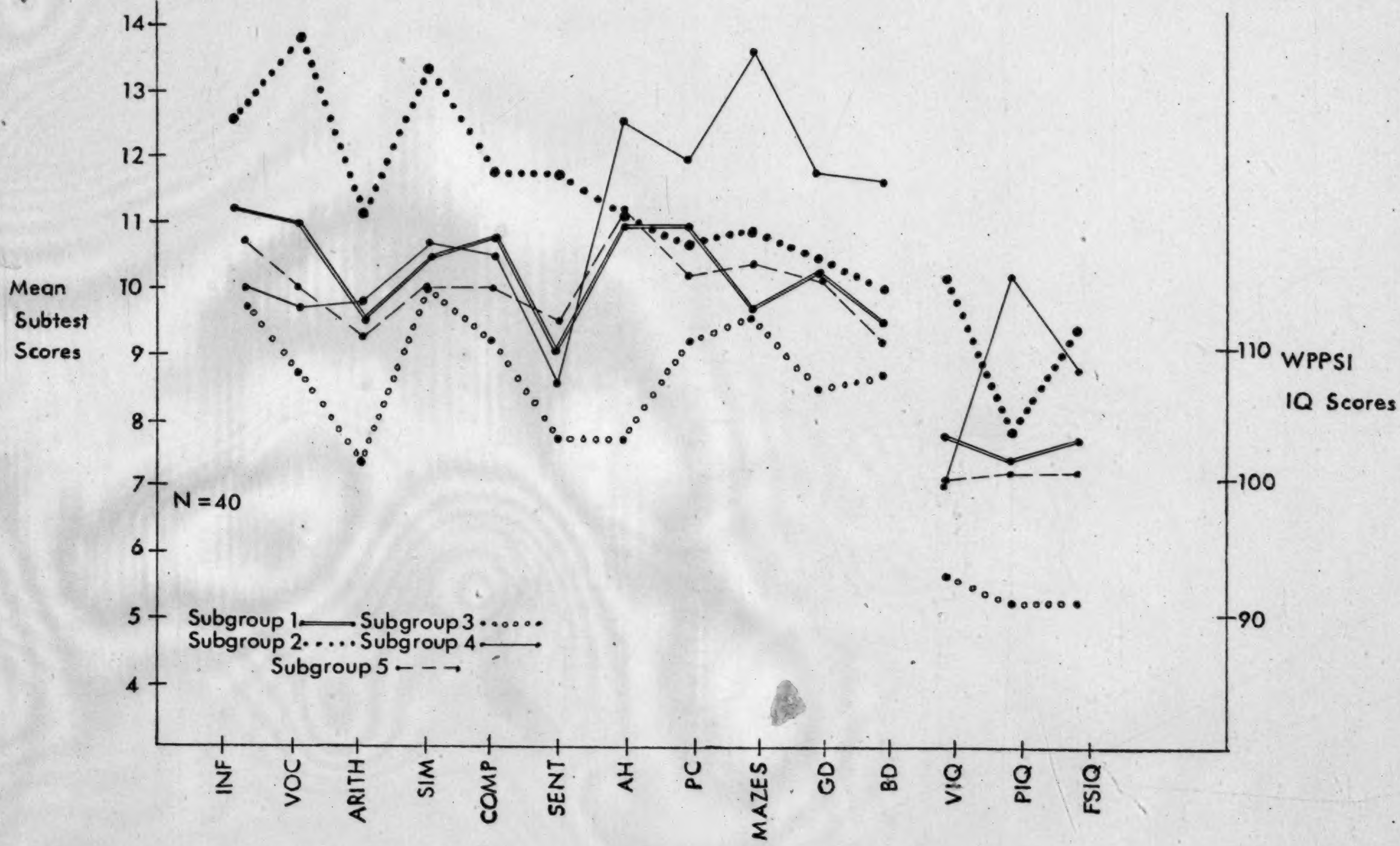

Figure 9. Mean WPPSI subtest and IQ scores for five subgroups of achieving children.

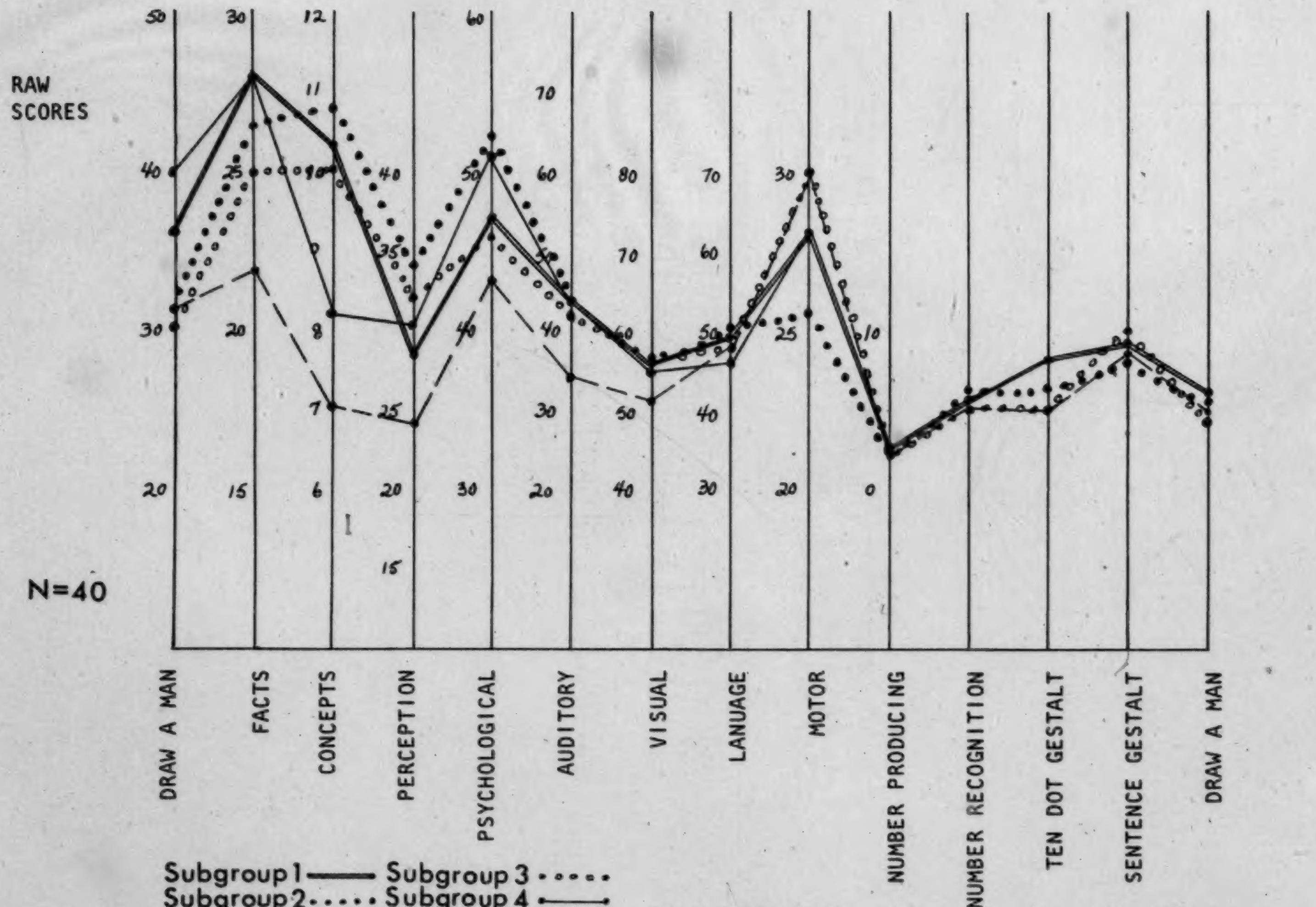

Figure 10. Mean raw scores for five subgroups of achieving children on subsections of the ABC, Dallas and Anton Brenner.

achieving children, the children in subgroup 3 score at a median to high level on sections of screening tests of academic readiness that measure language and memory skills, i.e., Dallas Auditory and Language and ABC Concepts tests (see Figure 10). Although a memory deficit is indicated in the WPPSI profile, if the deficit exists it does not appear to be affecting the performance of the subgroup 3 children on screening tests of academic readiness.

The superior WPPSI performance subtest scores in Figure 9 indicate that the children in subgroup 4 (N = 7) are bright in nonverbal skills. The children in this subgroup appear to have average verbal skills as indicated by their average WPPSI verbal subtest scores. Because of their superior nonverbal skills, subgroup 4 children would be expected to score highest overall on screening tests of motor skills. However, the children scored highest on the ABC Draw A Man test and at a median level on the remaining tests of perceptual organization skills, e.g., Dallas Visual and Motor tests. The mean Davids score for subgroup 4 children is 18 which is indicative of normal classroom behavior.

The achieving children in subgroup 5 (N = 4), like the children in subgroup 1, appear to have average intellectual skills. As shown in Figure 9, the WPPSI verbal and performance subtests for these children are within the average range. However, in Figure 10 the subgroup 5 children score lowest among the achieving children on screening tests of language and motor skills, e.g., ABC Facts and Dallas Visual tests. Although no learning problems were reported for the four children in subgroup 5 , the children were rated by their teachers with a mean score of 22 on the Davids which is indicative of hyperkinetic behavior.

Although patterns of WPPSI and screening test scores are evident in Figures 9 and 10 for the achieving children, the patterns appear to represent a normal variation between skills rather than deficit areas of functioning. With the exception of the four subgroup 3 children, the WPPSI subtest scores of the achieving children are well within the average range of functioning. With the exception of the four achieving children in subgroup 5, average score levels are demonstrated in the screening test score profiles for the achieving children.

While patterns of test scores exist for both sample groups, the patterns for the subgroups of nonachieving children are distinct and they differ from the patterns for the achieving children. The test score profiles for the subgroups of nonachieving children indicate that different kinds of deficits characterize the functioning of these children. In addition, the WPPSI and screening test score patterns differ for the two sample groups in terms of degree. Patterns of discrepant and below average scores characterize the psychometric profiles for the subgroups of nonachieving children.

In summary, the Q method of factor analysis was used to identify five subgroups of achieving and nonachieving children. The results of an empirical analysis of the test score profiles of each subgroup are reported in this section. The results demonstrate that the subgroups of children can be described and differentiated on the basis of test score profiles. The score profiles for each subgroup of achieving children demonstrated variation within a normal range of functioning, although subgroup 3 children presented with possible memory problems. However, the profiles for the subgroups of nonachieving children differed from each other and from the achieving children as to both the degree and the kind of skill deficits demonstrated. The psychometric score profiles for the nonachieving subgroup 1 children indicated that the children were dysfunctional in language and presented with the characteristics of hypoactive behavior. Subgroup 2 children had a spatial deficit while the children in subgroup 3 presented as being hyperkinetic and with borderline ability. The children in subgroups 3 and 4 had moderate and severe language problems respectively.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The present study was designed to seek answers to questions regarding: (a) the factor structure of the WPPSI; (b) the psychoeducational diagnostic utility of the WPPSI and screening tests of readiness for academic learning; (c) the relationship between patterns of test scores within and between subgroups of achieving and nonachieving children. Forty achieving and 40 nonachieving children in the 60 to 78 month age range were selected for the study. A test battery consisting of the WPPSI and three screening tests of academic readiness were administered individually to each child. In addition, each child was rated by his classroom teacher on a scale which was designed to predict the syndrome of hyperkinesis.

Computer programs were used in order to obtain descriptive statistics and to perform tests of significance, factor and stepwise regression analyses. In addition, the test score profiles for the children in each subgroup were described. The results of the analyses of the data indicated that the children in the achieving and nonachieving sample groups differed in several important respects. The conclusions drawn from the analyses of the data presented in the preceding chapter will be discussed for each of the questions posed for investigation.

Questions Related to the Factor Structure of the WPPSI

Question 1. Do factors emerge in factor analyses of the WPPSI subtest scores for each sample group?

The finding that the WPPSI subtests for the children in both sample groups loaded on a general and on two specific factors was in agreement with the finding reported in studies of the original WPPSI standardization sample (i.e., Hollenback & Kaufman, 1973; Mukherjee, 1975; Wallbrown, Blaha & Wherry, 1973). The findings in the present study supported the theoretical division and the organization of the WPPSI into three scales, i.e., verbal, performance and full scale. The findings were also in agreement with researchers such as Hagen and Kaufman (1975) who reported that the factor structure of the WISC-R remained the same for children in different clinical groups. Because the factor structure of the WPPSI remained the same for each sample group, the use of the WPPSI for assessing the intellectual development of both achieving and nonachieving children was supported.

Question 2. If factors do emerge for the WPPSI, will the factors be similar for the achieving and nonachieving groups?

Although the WPPSI subtests for both sample groups were significantly loaded on a general and two specific factors, the rank order of the loading weights differed for the sample groups. The differences in the order of subtests loading the factors was attributed to both the small sample size used in the study and to differences in the intellectual skill development of the achieving and nonachieving children.

The rank order of the WPPSI performance subtests for the achieving children was the same as the order of subtests loading on a nonverbal factor reported by Hollenback and Kaufman (1973) for the original WPPSI standardization sample. Moreover, only two verbal subtests (i.e., Vocabulary and Similarities) for the achieving children failed to load on the verbal factor in the order reported by Hollenback and Kaufman (1973). These findings indicate that the WPPSI factors for the achieving children are similar to the factors for the so-called normal, standardization group.

The rank order of the subtests loading the factors for the nonachieving children was different from the order of subtests loading on the factors for the achieving and the WPPSI standardization groups. A social comprehension and language factor (i.e., loaded by the Comprehension, Similarities and Vocabulary subtests) and a perceptual organization factor (i.e., loaded by the Mazes and Block Design subtests) were the best respective predictors of verbal and nonverbal abilities for the nonachieving children. Because of the magnitude of the respective subtest loadings on the verbal and the nonverbal factors, it was concluded that both language and perceptual organization skills were characteristic of the intellectual functioning of the nonachieving children.

The results of the factor analysis of the WPPSI and screening test scores combined for each group indicated that tests measuring perceptual (i.e., auditory memory, visual motor) and language (i.e., word recognition, expressive vocabulary) skills emerged as stronger factors for the nonachieving children, i.e., factor loadings were higher. The finding was in direct contrast for the achieving children. For these children, intellectual factors rather than readiness factors emerged as the stronger factors, i.e., factor loadings were higher and contributed more to total variance. The finding is in agreement with authors such as Adelman (1978) who claimed that because of the heterogeneous nature of learning disability, children with a learning disability require specific skills for successful academic task completion. The finding indicates that intelligence may be a less important predictor of success for the nonachieving children and that language and visual motor readiness skills were relatively stronger as predictors of success in the day-to-day academic functioning of these children.

Question 3. If factors do emerge for the WPPSI, are they similar to the factors on the WISC-R as identified by researchers such as Kaufman (1975)?

There were no instances in the present study where the rank order of the subtests loading on the WPPSI factors were the same as the rank order of the WISC-R subtest loadings reported by Kaufman (1975). Although patterns of subtest loadings that resembled WISC-R patterns were found to exist in the present study, the comparisons were unclear. For example, Kaufman (1975) reported that the same four WISC-R verbal subtests loaded on a verbal factor for the children across the different age levels in the original standardization group, i.e., Vocabulary, Information, Comprehension and Similarities. With the exception of the Similarities subtest for the achieving children, for each sample group the same WPPSI subtests were found to load the verbal factor. However, the different rank ordering of the subtests made it difficult to assess the degree of similarity of the two factors on the WPPSI and the WISC-R.

The author concluded therefore that the verbal and nonverbal factor structures of the WPPSI and WISC-R were similar; verbal and performance subtests loaded on the verbal and nonverbal factors respectively. However, there was no evidence in the results to support a memory or freedom from distractibility factor as identified by Kaufman (1975) for the WISC-R or Cohen (1959) for the WISC. The WPPSI subtests that were thought to require memory skills (i.e., Animal House, Sentences, Arithmetic) were significantly loaded on either a verbal or nonverbal factor in the factor solutions for each of the sample groups. The finding that a memory factor did not emerge was support for Kaufman's (1975) position that such a factor may not emerge until age 7. In summary, it was concluded that the results of the present study did not support a three factor (i.e., specific factor) structure for the WPPSI.

Questions Related to the Psychoeducational Diagnostic Utility of the WPPSI and Screening Tests for Academic Learning

Question 4. Will the WPPSI subtests loading the factors for the achieving and nonachieving groups be similar to the WISC-R patterns as identified by researchers such as Bannatyne (1974)?

With one exception the WPPSI subtests loading the verbal factor for both sample groups were the same as the WISC-R subtests identified by Bannatyne (1974) as forming the Conceptual Category, i.e., Vocabulary, Comprehension and Similarities. The one exception was the Similarities subtest for the achieving children which did not form part of the Conceptual Category. For both sample groups, little similarity was found between the patterns of subtests loading on the WPPSI factors and the WISC-R subtests forming the Spatial, Sequential or Acquired Information Categories as reported by Bannatyne (1974).

Although the subtests loading on the WPPSI factors did not conform to the WISC-R subtests forming three of the categories reported by Bannatyne (1974), the WPPSI results for the nonachieving children were similar to the results reported by Rugel (1974) for reading disabled children. Rugel reported that reading disabled children, as a group, scored highest on Bannatyne's Spatial Category, next highest on Conceptual and lowest on the Sequential Category. The results showed that the nonachieving children score highest on the WPPSI performance subtests, next highest on the verbal subtests and lowest on the WPPSI Sentences and Arithmetic subtests (see Figure 1). While the achieving children scored lowest on the Arithmetic subtest, the verbal subtest scores for this group were higher than the performance subtest scores, which was in contrast to the finding for the nonachieving children. The mean WPPSI subtest scores from the descriptive data also demonstrate the utility of using the Conceptual and Spatial categories in describing the learning deficits of young children.

Question 5. Will subtest scores on the WPPSI correlate significantly with performance as assessed by the screening measures used?

The finding that three subtests (i.e., Similarities, Sentences and Block Design) predict performance on screening tests of academic readiness will be of interest to clinicians who use the WPPSI. When WPPSI subtest scores are available, the scores on the Similarities, Sentences and Block Design subtests are useful in identifying children who, if left untreated, may become learning disabled.

The results of the factor analyses of the screening tests of academic readiness for each sample group (see Table 6) indicated that five tests loaded higher on the factors for the nonachieving children than for the achieving children, i.e., ABC Concepts and Copying a Square, Dallas Auditory and Language and Brenner Ten Dot Gestalt tests. The results indicated that these specific tests best predicted the performance of the nonachieving children on screening tests of academic readiness. The finding is in agreement with Satz and Friel (1978) who reported that readiness tests of visual motor integration and language were valid predictors of the learning problems of kindergarten children over a three year period. If WPPSI subtest sccores are available, the three subtests reported earlier could be used to identify the child with potential problems in academic readiness. A shortened screening test battery employing academic readiness tests such as the ones just described may be useful to directly assess children's readiness for academic learning.

Questions Related to the Relationship Between Patterns of Test Scores Within and Between Subgroups of Achieving and Nonachieving Children

Question 6. Do children in the sample groups sort out into subgroups that are characterized by different patterns of functioning?

The results of the empirical analysis of the psychometric profile for the subgroups in each sample group confirmed that the Q technique of factor analysis formed homogeneous subgroups of children. On the basis of intelligence, academic readiness and behavior rating scores, and as confirmed by clinical information on individual children, it was possible to differentiate the children in the subgroups. Although the subgrouping procedure used in the present study resulted from psychometric rather than direct diagnostic (i.e., academic) assessments, the subgroups of nonachieving children with one exception were similar to subgroups of dysfunctional children identified by other researchers.

The one subgroup which did not clearly resemble dysfunctional groups identified by other researchers was subgroup 1. Although the children in the subgroup were suspected to being dysfunctional in language, the clinical information concerning hypoactive, withdrawn behavior made it difficult to confirm a differential diagnosis. It was not known from the psychometric profile, for example, whether the main presenting problem of these children was one of affect (e.g., confidence, outgoing behavior) or specific language deficit (e.g., speaking vocabulary). On the other hand, it was possible that the hypoactivity of these children may have resulted from a difficulty understanding what was going on in their immediate environment. The children in subgroup 1 may have been unsure of themselves and they may have coped by avoiding language activities, particularly those requiring oral expression.

The spatial problems of children in subgroup 2 were similar to the deficits presented by the children in subgroups of reading disabled children reported by Boder (1975) and Fuller and Friedrick (1974). Boder (1975) reported that one of her reading disabled groups was dysfunctional in spatial skills which reflected in a deficit in the ability to visualize and remember letters and words. The Secondary Reading group reported by Fuller and Friedrick (1974) also had spatial problems which reflected in a motor planning deficit. The children in subgroup 2 were also similar to children identified by Wallbrown, Blaha and Vance (1980) as presenting with a perceptual organization deficit.

The children in subgroup 3 were similar to the children identified by Wallbrown, Blaha and Vance (1980) as being distractible. The children in the present study and those described by Wallbrown and his colleagues had their lowest respective scores on WPPSI and WISC-R subtests that measured short term memory skills, i.e., Arithmetic, Sentences and Animal House and Arithmetic and Digit Span.

The children in subgroups 4 and 5 had a language dysfunction that differed on the degree of severity. The children in both subgroups presented with the same deficits as groups of reading disabled children identified in other studies. For example, Boder (1975) described a group of disabled readers (i.e., dysphonetics) having poor verbal reasoning and language skills. The children in subgroups 4 and 5 also resembled a group described by Fuller and Friedrick (1974) as having a general verbal deficiency.

While it was possible to differentiate and diagnose the learning problems of the nonachieving children, it was also possible to conclude that remedial and compensatory activities were necessary for the nonachieving children in each subgroup. While the children in subgroup 1 appeared to require success oriented language development activities, subgroup 2 children required specific remedial activities matched to the developmental level of motor skills presented by each child. Children in subgroup 3 appeared to require behavior modification and listening skills programs. While the children in subgroups 3 and 4 presented with similar problems, the children in subgroup 4 required a total language development program. Because of the similarity between the psychometric profiles for the subgroups of nonachieving children and the presenting behaviors of the reading disabled children reported in the literature, it is hypothesized that without intervention many of the nonachieving children will likely have learning problems in school.

The results of the profile analysis indicated the relationship between level of intelligence and academic readiness skills was not necessarily direct. For example, while the achieving children in subgroup 3 had lower WPPSI IQ scores than the nonachieving children in subgroups 1, 2, 4 and 5, the screening test scores of the achieving children were higher. Moreover, the nonachieving children in subgroup 3 had the lowest WPPSI IQ scores overall; however, the screening test performance of these children was at a median level among the nonachieving children. The last point is significant because six of the eight children with below average IQ scores selected for the study were included in subgroup 3. Relatively lower or higher intellectual abilities did not have a direct relationship with performance on screening tests, particularly for children with deficit areas of functioning. The importance of considering both intellectual and diagnostic information in making placement decisions is underscored by this finding.

Summary of Findings

The major findings of the present investigation were:

1. The organization of the WPPSI into a general (i.e., full scale) and two specific (i.e., verbal and performance) scales for use with achieving and nonachieving children was confirmed.

2. Although the WPPSI factor structure was replicated for nonachieving children, there were differences between the factors for the nonachieving and so-called normal groups.

3. No freedom from distractibility factor or third specific factor was found for the WPPSI.

4. Although the WPPSI score patterns for the nonachieving children were similar to the WISC-R patterns reported by Rugel (1974) for disabled readers, the WPPSI factor structure did not conform completely to Bannatyne's WISC-R subtest categorization.

5. Three WPPSI subtests (i.e., Similarities, Sentences, Block Design) may be useful in identifying children with learning problems and a screening battery consisting of readiness tasks (i.e., visual motor and language) may be useful in direct assessment of academic readiness skills.

6. The heterogeneous nature of the nonachieving group was confirmed by a statistical classification procedure and by an empirical analysis of subgroup test score profiles.

7. The nonachieving children presented as a heterogeneous group with language and perceptual skills emerging as common factors in daily academic functioning.

8. The level of intelligence as measured by the WPPSI did not have a direct influence on the level of performance on screening tests of academic readiness although patterns of skill deficits were related.

9. In addition to IQ level, other developmental information must be considered when making placement decisions concerning children with below average IQ scores.

In the present study an attempt was made to assess the utility of a battery of tests for use in the identification and diagnosis of children with learning problems. The study was conducted in order to obtain information of use for the classroom teacher in meeting the needs of young, educationally at risk children. There were limitations to the study. The limitations were:

1. The study had a small sample size and the confounding effects of other variables such as residence have to be considered.

2. Sections of the screening tests (i.e. Dallas Psychological) were poorly defined and some contamination was evident in the factor solutions for the screening tests.

3. For the study, learning disability was conceptualized as a symptom rather than a syndrome. The finding of the heterogeneous nature of learning disability (i.e.,for the nonachieving children) makes it difficult to generalize present results to other groups of learning disabled children.

Recommendations

Based on the results of the study and in order to plan for additional research the following recommendations are made:

1. A follow-up or longitudinal study would be of use in determining the predictive validity of the psychometric measures used in the study. It is recommended that the screening tests of academic readiness be administered to children at the end of a kindergarten year and that the academic progress of the children by followed over a three year period.

2. Because of the heterogeneous nature of learning disability, continued research on the subgrouping of children and the analysis of the intellectual, academic readiness and behavioral correlates of each subgroup is required particularly for young children.

3. Psychometric profiles represent a useful beginning in psychoeducational diagnosis, however, diagnostic information must also be based on an interactive, direct diagnostic approach to student assessment.

4. Further research with groups of young children matched on IQ

level is recommended. It is recognized that learning disabled children as a group test in the borderline range of intelligence. Further research using groups of achieving and nonachieving children matched on IQ level is necessary in order to determine whether learning difficulties can be accounted for by level of IQ.

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APPENDIX A

REFERRAL FORM TO LEARNING ASSISTANCE CENTRE

DATE: ____________________

STUDENT'S NAME: ____________________ SEX: ____________________

BIRTHDATE: ____________________ AGE: ____________________

MAILING ADDRESS: ____________________ PHONE: ____________________

SCHOOL: ______________ GRADE/LEVEL: ____ TEACHER: ______________

GRADES REPEATED: ______________ GRADES ACCELERATED: ______________

FATHER'S NAME: ______________ OCCUPATION: ______________

MOTHER'S NAME: ______________ OCCUPATION: ______________

REFERRED BY: ____

REASON FOR REFERRAL: ____

____

HAS THIS REFERRAL BEEN DISCUSSED WITH THE PARENTS? ______________

WHAT IS THE PARENTS' ATTITUDE REGARDING THIS REFERRAL? ______________

____

SIGNIFICANT HEALTH AND PHYSICAL FACTORS: ______________________

____

SCHOOL ATTENDANCE:

☐ GOOD ☐ FAIR ☐ POOR

STANDARDIZED TESTS: (Not for E.C.S.)

	DATE OF TEST	TYPE	RESULT
MOST RECENT INTELLIGENCE:			
OTHER:			

HAS THE CHILD BEEN SEEN FOR A PREVIOUS ASSESSMENT? (PSYCHOLOGICAL OR OTHER) ____

WHEN AND BY WHOM? ____

OUTSTANDING INTERESTS:

1. IN SCHOOL ______________________________

____

2. OUT OF SCHOOL ______________________________

____

TEACHER'S IMPRESSION OF CHILD'S:

1. ATTITUDE TO SCHOOL WORK ______________________________

____

2. RELATIONSHIP WITH OTHERS IN THE CLASSROOM ______________________________

____

3. RELATIONSHIP WITH OTHERS ______________________________

____

4. RELATIONSHIP WITH TEACHER ______________________________

____

PERSONALITY: Check (✓) the words that seem to describe the child at this time.

1. Daydreams ___
2. Temper Outbursts ___
3. Uncooperative ___
4. Easily Upset ___
5. Talkative ___
6. Over-active ___
7. Aggressive ___
8. Nervous ___
9. Easily Discouraged ___
10. Short Attention Span ___

DOES THE CHILD APPEAR TO HAVE A SPEECH, LANGUAGE OR HEARING PROBLEM? If so, describe and indicate possible cause(s).

____

____

TEACHER'S COMMENTS: (attach extra pages if desirable).

____

____

____

Revised August 28, 1978

APPENDIX B

LETTER TO PARENTS

11722 - 94A Street
Grande Prairie, Alberta
T8V 4R9

Dear

I am an educational psychologist with Alberta Education in Grande Prairie completing a research study for the University of Alberta. I would like to request your permission to work with your child in kindergarten for approximately one hour to obtain information for my study.

In my daily work with young children I have found that children with learning problems make similar errors on a group of short paper and pencil tests. I have observed common errors in skill areas such as drawing, copying, following directions and defining words. I would now like to find out whether a second group of children who are achieving with relative ease make the same types of errors. I have discussed this study with the West Central ECS Co-ordinator. The names of children in this second group were chosen at random from the West Central class lists; no contact will be made with the kindergarten concerning your child without your written permission.

Since this is a research study, the results will be used for statistical purposes; no written reports or permanent records will be made. As a parent you may be interested in your child's responses; I am willing to discuss these with you in person or by telephone.

Your assistance in helping me to complete this study would be greatly appreciated. Before working with your child I require your consent. For that purpose I have attached a form that should be signed and returned to me in the envelop provided.

If you have any questions or require any further information, please give me a call at 539-3546 (home) or 539-2130 (office).

Yours truly,

Enc.- Rick Morrow

APPENDIX C

PERMISSION FORM

I grant permission for Mr. R. Morrow to have my son/daughter, ________________ (name), complete four pre-school tests for research purposes.

____

Parent signature

I would like to:

______ receive a phone call concerning my child's results.

______ meet personally to discuss my child's results.

______ do not require a phone call or meeting.

APPENDIX D

DAVIDS RATING SCALE FOR HYPERKINESIS

General Directions for Administering and Scoring the Rating Scale:

Child's Name ______________________ Birth Date __________________

Rater's Name ______________________ Date of Rating ______________

Please rate the child on each of the characteristics (or behavior) listed on the following scales. Place a check mark at the point on the scale indicative of your estimate of the degree to which the child possesses the particular characteristic.

As you make each rating, judge the child in comparison with other children of the same sex and age. That is, the ratings should indicate your estimate of the child's behavior in comparison with the behavior displayed by other "normal children."

For each of the characteristics defined, place a check mark at one of the six points on the scales running from "much less than most children" to "much more than most children." Do not mark the midpoint on any of the scales. Even though it may sometimes be difficult to make a judgment, please make a rating on one or other side of the scale.

DAVIDS RATING SCALE OF HYPERKINESIS

1. Hyperactivity: Involuntary and constant overactivity; advanced motor development (throwing things, walking, running, etc.); rather run than walk; rarely sits still.

1	2	3	4	5	6
Much Less than Other Children	Less	Slightly Less	Slightly More	More	Much More than Other Children

2. Short Attention Span and Poor Powers of Concentration: Concentration on a single activity is usually short, with frequent shifting from one activity to another; rarely sticks to a single task very long.

1	2	3	4	5	6
Much Less than Other Children	Less	Slightly Less	Slightly More	More	Much More than Other Children

3. Variability: Behavior is unpredictable, with wide fluctuations in performance; "Sometimes he (or she) is good and sometimes bad."

1	2	3	4	5	6
Much Less than Other Children	Less	Slightly Less	Slightly More	More	Much More than Other Children

4. Impulsiveness and Inability to Delay Gratification: Does things on the spur of the moment without thinking; seems unable to tolerate any delay in gratification of his (her) needs and demands; when wants anything, he (she) wants it immediately; does not look ahead or work toward future goals; thinks only of immediate situation.

1	2	3	4	5	6
Much Less than Other Children	Less	Slightly Less	Slightly More	More	Much More than Other Children

5. Irritability: Frustration tolerance is low; frequently in an ugly mood, often unprovoked; easily upset if everything does not work out just the way he (she) desires.

1	2	3	4	5	6
Much Less than Other Children	Less	Slightly Less	Slightly More	More	Much More than Other Children

6. Explosiveness: Fits of anger are easily provoked; reactions are often almost volcanic in their intensity; shows explosive, temper-tantrum type of emotional outbursts.

1	2	3	4	5	6
Much Less than Other Children	Less	Slightly Less	Slightly More	More	Much More than Other Children

Scoring: Each of the traits is scored from 1 to 6:

Much less than other children	1
Less	2
Slightly less	3
Slightly more	4
More	5
Much more than other children	6

Total score for 6 traits. A score of 24 or more suggests the presence of hyperactivity; scores of 19 to 23 are regarded as suspicious; 18 or less is viewed as indicating the absence of significant hyperkinesis in the child.

APPENDIX E

DATA INFORMATION SHEET

A. STUDENT INFORMATION

Student Name: ____________________

Sex: Male ______ Female ______

School/ECS: ____________________

Chronological Age: _______ yrs.

______ months

Parent Occupation: _______________

B. TEST RESULTS

I. Hyperkinesis Scale

II. ABC Inventory

Raw Score _______________

Readiness Age _____________

III. Wechsler Preschool and Primary Scale of Intelligence

SUBTEST SCORES:

Information _______________

Vocabulary _______________

Arithmetic _______________

Similarities _______________

Comprehension _______________

Sentences _______________

Animal House _______________

Picture Completion _______________

Mazes _______________

Geometric Design _______________

Block Design _______________

Verbal IQ _______________

Performance IQ _______________

Full Scale IQ _______________

IV. Dallas Pre-school Screening Test

STANDARD SCORES:

Psychological _______________

Auditory _______________

Visual _______________

Language _______________

Motor _______________

V. Anton Brenner Gestalt School Readiness

	Plus	Minus	Zero
Numbers Prod.	____	____	____
No. Recog.	____	____	____
Ten Dot Gest.	____	____	____
Sent. Gestalt	____	____	____
Draw A Man	____	____	____

BGT Total Sc. _______________

Readiness Ev. Low Avg. High

APPENDIX F

Chronological Age, Sex, WPPSI IQ Scores and Residence of Achieving Children

Subject	Age In Months	Sex	VIQ	PIQ	FSIQ	Residence
1	69	F	115	100	109	Rural
2	64	M	102	111	107	Urban
3	67	M	105	99	102	Urban
4	68	M	100	101	101	Rural
5	62	M	95	115	105	Urban
6	68	M	95	91	92	Rural
7	62	M	92	88	90	Rural
8	60	M	110	115	114	Rural
9	66	M	117	101	111	Rural
10	70	M	101	95	98	Rural
11	73	M	116	95	106	Rural
12	73	M	100	100	100	Rural
13	69	F	105	107	106	Rural
14	63	M	131	119	128	Rural
15	70	M	97	114	106	Rural
16	64	M	110	110	111	Rural
17	76	M	102	110	106	Rural
18	65	M	126	111	121	Rural
19	76	M	97	107	102	Rural
20	71	M	104	101	103	Rural
21	69	M	90	122	106	Rural
22	69	F	111	110	112	Rural
23	65	M	97	115	106	Rural
24	71	M	95	86	90	Rural
25	72	M	122	99	112	Urban
26	69	F	114	97	106	Rural
27	72	M	104	104	104	Rural
28	69	M	102	116	110	Rural
29	61	M	119	104	113	Rural
30	64	M	114	119	118	Rural
31	68	F	111	107	110	Rural
32	63	F	111	111	112	Rural
33	69	M	115	107	112	Rural
34	73	M	90	99	93	Rural
35	63	M	99	97	98	Rural
36	65	M	110	100	106	Rural
37	66	M	95	91	92	Rural
38	73	F	97	97	97	Rural
39	74	M	92	91	91	Rural
40	69	F	105	107	106	Rural

APPENDIX G

Chronological Age, Sex, WPPSI IQ Scores and Residence of Non-Achieving Children

Subject	Age In Months	Sex	VIQ	PIQ	FSIQ	Residence
1	72	F	65	118	90	Urban
2	72	F	64	123	91	Urban
3	67	F	99	97	98	Rural
4	65	M	94	89	91	Rural
5	66	M	67	80	71	Rural
6	68	M	91	103	96	Rural
7	73	M	86	99	91	Rural
8	66	M	89	96	91	Rural
9	76	M	71	84	75	Rural
10	63	F	121	97	111	Rural
11	60	M	89	85	86	Rural
12	76	M	81	80	80	Rural
13	78	F	112	118	116	Rural
14	78	M	91	86	88	Rural
15	69	M	92	114	103	Rural
16	77	M	90	84	85	Rural
17	67	M	75	67	69	Rural
18	62	M	104	104	104	Rural
19	68	M	89	91	90	Rural
20	73	M	85	104	93	Rural
21	73	M	102	107	105	Rural
22	77	M	90	82	85	Rural
23	72	M	115	103	110	Urban
24	75	M	80	86	82	Rural
25	70	M	107	90	99	Rural
26	69	M	117	99	109	Rural
27	73	M	81	105	92	Rural
28	70	M	71	92	79	Rural
29	72	M	80	81	80	Rural
30	64	M	102	106	108	Rural
31	77	M	82	92	86	Urban
32	60	F	87	95	90	Rural
33	75	M	101	108	105	Rural
34	67	M	89	111	99	Rural
35	77	M	69	92	80	Rural
36	66	M	84	107	94	Rural
37	69	M	74	86	78	Rural
38	75	M	90	77	82	Rural
39	63	M	82	93	86	Rural
40	71	F	102	112	108	Urban

APPENDIX H

Characteristics of Test Scores of Two Groups of Subjects

Test	Achieving			Non-Achieving		
	Range	Mean	Standard Deviation	Range	Mean	Standard Deviation
WPPSI Subtests						
Information	6-17	11.17	2.20	3-15	8.50	2.61
Vocabulary	8-17	11.25	2.67	2-16	7.87	3.05
Arithmetic	7-13	9.77	1.60	4-12	7.57	2.04
Similarities	6-19	11.20	2.61	2-14	8.45	2.76
Comprehension	7-16	10.87	1.84	3-17	8.65	2.88
Sentences	7-14	10.25	1.93	3-12	7.22	2.52
Animal House	7-15	11.05	1.99	4-15	9.22	2.50
Picture Completion	8-16	10.87	1.58	6-14	9.47	2.19
Mazes	7-18	10.72	2.24	5-14	9.50	2.25
Geometric Design	7-14	10.45	1.48	3-18	9.77	2.67
Block Design	8-14	9.95	1.53	5-14	9.05	2.34
ABC Sub-tests						
DAM	20-44	33.80	6.00	4-48	30.00	9.92
Facts	20-34	27.20	3.13	9-30	20.67	5.85
Concepts	4-12	9.75	1.93	0-12	7.25	3.02
Perception	16-32	29.20	4.63	8-32	25.40	7.22
Dallas Subtests						
Psychological	40-59	48.35	5.04	19-59	42.20	10.53
Auditory	31-54	42.65	6.23	9-54	30.40	11.19
Visual	39-62	55.17	4.49	27-62	50.02	10.72

Test	Achieving			Non-Achieving		
	Range	Mean	Standard Deviation	Range	Mean	Standard Deviation
Language	39-56	49.35	4.49	20-56	39.12	8.29
Motor	19-30	27.90	3.48	10-30	24.12	6.83
David's Subtests						
Hyperactivity	1-6	3.42	1.50	1-6	3.72	1.35
Attention Span	1-6	3.32	1.30	1-6	4.47	1.37
Variability	1-5	2.77	1.20	2-6	3.50	1.17
Impulsivity	1-6	3.02	1.36	2-6	3.82	1.25
Irritability	1-5	2.37	1.00	1-6	2.72	1.21
Explosiveness	1-5	1.97	.92	1-5	2.32	1.04
Brenner Subtests						
Number Production	1-3	2.42	.54	1-3	2.40	.67
Number Recognition	4-6	5.75	.54	3-6	5.17	.93
Ten Dot	1-9	6.95	2.66	0-9	5.50	3.21
Sentence Gestalt	4-12	9.25	2.16	0-12	8.85	3.35
DAM	4-7	5.42	1.03	0-8	4.77	1.79

APPENDIX I

Results of t Tests on Means of Test Variables for Two Groups of Subjects

Variable	F Value	2 Tail Probability	Pooled Variance T Value	Pooled Variance 2 Tail Probability	Separate Variance T Value	Separate Variance 2 Tail Probability
WPPSI Subtests						
Information	1.40	.29	4.95	.00*		
Vocabulary	1.30	.41	5.25	.00*		
Arithmetic	1.62	.13	5.34	.00*		
Similarities	1.12	.72	4.57	.00*		
Comprehension	2.46	.006*			4.11	.00*
Sentences	1.71	.09	6.02	.00*		
Animal House	1.57	.16	3.60	.001*		
Picture Completion	1.91	.04*			3.27	.002*
Mazes	1.01	.97	2.44	.01*		
Geometric Design	3.25	.00*			1.40	.16
Block Design	2.33	.01*			2.03	.04*
ABC Subtests						
DAM	2.73	.002*			2.07	.04*
Facts	3.50	.00*			6.21	.00*
Concepts	2.46	.006*			4.40	.00*
Perception	2.43	.007*			2.80	.007*

Variable	F Value	2 Tail Probability	Pooled Variance T Value	Pooled Variance 2 Tail Probability	Separate Variance T Value	Separate Variance 2 Tail Probability
Dallas Subtests						
Psychological	4.37	.00*			3.33	.002*
Auditory	3.23	.00*			6.05	.00*
Visual	5.70	.00*			2.80	.007*
Language	3.41	.00*			6.85	.00*
Motor	3.84	.00*			3.11	.003*
David's Subtests						
Hyperactivity	1.22	.53	.94	.35		
Attention Span	1.11	.75	3.83	.00*		
Variability	1.06	.86	2.72	.008*		
Impulsivity	1.18	.60	2.72	.008*		
Irritability	1.47	.23	1.40	.16		
Explosiveness	1.30	.42	1.59	.11		
Brenner Subtests						
Number Producing	1.49	.21	.18	.85		
Number Recognition	2.94	.001*			3.38	.001*
Ten Dot	1.46	.23	2.20	.03*		
Sentence Gestalt	2.39	.008*			.63	.52
DAM	2.99	.001*			1.99	.05*

* denotes statistical significance at .05 confidence level